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POWER

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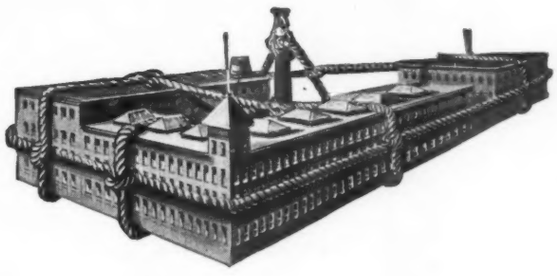

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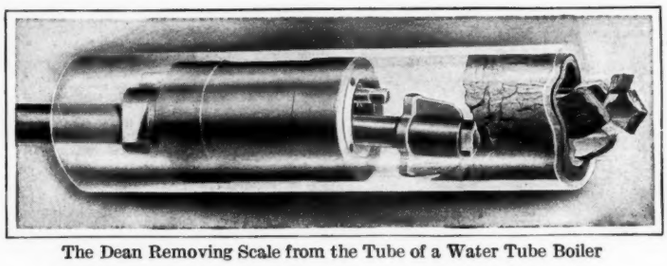

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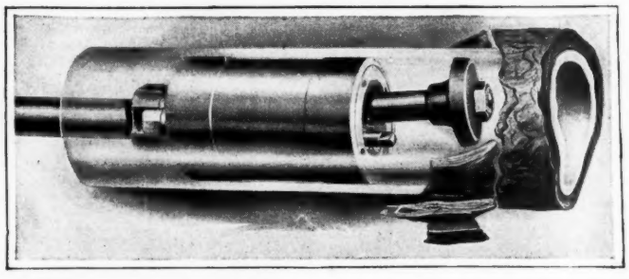

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Fig. 433
Brass, Top Outlet
Encased Spring

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of a safety valve is to Relieve an Excess of Pressure, But No More, and one that does relieve more is wasteful and expensive.

Neither is a valve with excessive lift needed, nor is it desirable. because it is not durable, as it causes a tremendous wear on the seating surface

Fig. 630
Iron
Encased Spring

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will Promptly Relieve the Overpressure Only, and nothing more. They can be regulated to reduce the pressure only one pound, if such close regulation is desired; will not chatter or hammer themselves to pieces, will not stick, and adjustment of the pop and pressure can be made from the outside of the valve.

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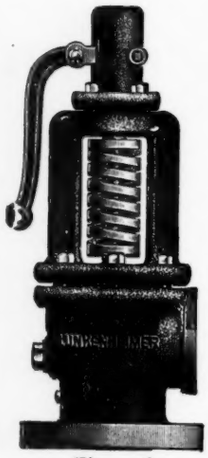

Fig. 146
Iron
Outside Spring

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4

Fig. 44
Brass
Outside Spring

Do You Want To Effect A Material Coal Saving?

Figure the coal saving you could effect if you had some means of keeping scale from incrusting the boiler tubes and plates. 1/16 inch of scale means 13% loss in heating capacity of the boiler.

Then remember that we have made a life work of preparing that kind of individual boiler feed treatment which will counteract the injurious elements in feed water and prevent scale formation —and that our many years of experience, handling thousands of separate cases, and our superior laboratory facilities are at your service.

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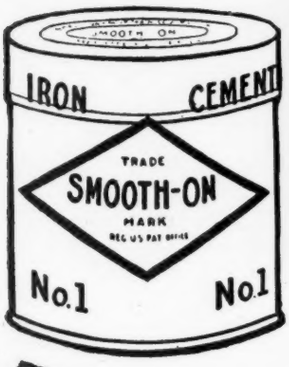

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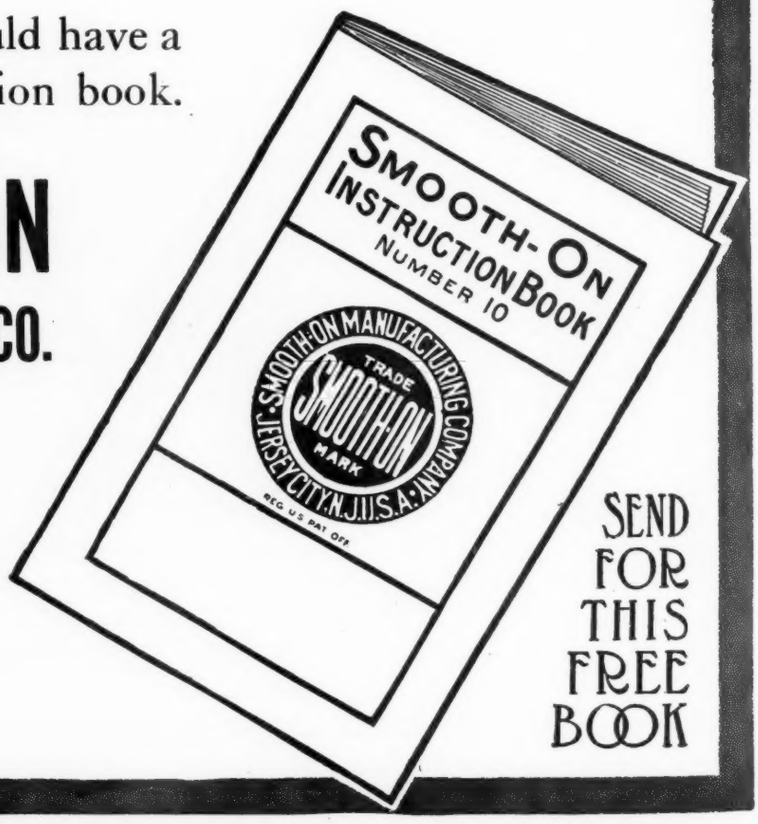

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POWER

Vol. 35 NEW YORK, MARCH 26, 1912 No. 13

NOT so many years ago, on the bank of most any Southern stream stood the negro log cabin; "razorbacks" rooted in the rich, damp soil, pickaninnies played or slept in the bright sunshine, and Uncle Eph'm just philosophized or temporized with his "prime mover" the mule—which moved when it had to and stopped when it could. And so did Uncle Eph.

Then, it was come-easy, go-easy, an' ole Missie done furnished de vittles!

Now, on every hand one sees manifestations of the development in the South; leisure has given way to progress; its lavish natural resources, including bountiful coal and iron deposits have been revealed.

Its manufacturing products amount to over a billion dollars annually; its exports to about four hundred million dollars. It has withstood tornadoes and devastations, and built up seaports which are the envy of the commercial world.

The prosperity of the South and its progress are mainly due to its equable climate and great natural resources. Its available waterpower is conservatively estimated to be equivalent to ten million horsepower and its coal deposits to contain over 600 billion tons.

That is a "lot" of coal.

If every one of the ninety million people in the country were capable of shoveling five tons a day, it would take them longer than three years, including Sundays and holidays, to "fire" this huge quantity.

The recent development of the city of Birmingham is somewhat indicative of the progressive spirit which pervades the "New South." In 1900 Birmingham had a population of 38,415; in 1910 the census returns showed her population to be 132,685, an increase of over 245 per cent. In 1900 eight and one-quarter million tons of coal were produced, while in 1910 over sixteen million tons were mined in and near that city.

We could go on and on, making one assertion after another and offering corroborative evidence, all to the effect that the South is the great country that it is. But, as the German comedian would say, "Enough is plenty."

Industrial growth must be accompanied by an increase in the number of opportunities for live, progressive engineers, for this is the age of mechanical power and, verily, industrial progress depends upon the motive power, be it water, gas or steam.

Elsewhere in this issue will be found a few practical instances of what has already been accomplished in power-plant development, of high-class engineering done under difficult conditions—of building to "stay put."

Combination Power and Ice Plant

By Paul C. Percy

A doubly composite plant in which both steam and gas are motive powers and the products are ice and electricity. The producers are fired with wood scraps.

The joint operation of an electric power plant and an ice-making plant has distinct advantages, provided the conditions are favorable, and this is more often the case than otherwise in Southern cities of moderate size, especially if the location is advantageous for the icing of refrigerator cars. Waycross, Ga., comes within this class. It is located on the main freight line between southern Florida and the rest of the United States and all fruit-carrying cars pass through it on the way to Northern and Central-western markets.

Being quick to recognize their vantage point, the managing officers of the Ware County Light & Power Co. have installed a thoroughly modern ice-making plant, with ample storage facilities, and are operating this plant eight months of each year in conjunction with the lighting and power plant which, of course, is operated continuously. The progressiveness of the management will be obvious when it is stated that the plant is operated 24 hours a day, except Sunday, although the town has a population of only 8000 and the day load ranges around 75 to 90 kw., according to the season; 24-hour service is not the rule under such conditions. To some extent, however, the operation of the ice plant conduces to the feasibility of maintaining day service from the electric plant—which is one of the advantages referred to in the preceding paragraph.

The company's station equipment is unusual, if not unique, considered as a combination. The prime movers are steam engines supplied by boilers fired with wood refuse burned in dutch-oven furnaces, and gas engines supplied by producers which gasify pine slabs, cypress stumps and roots, etc. At the time of the writer's visit, one producer was running on bituminous run-of-mine coal, but pine scrap alone had been used continuously for several months previous.

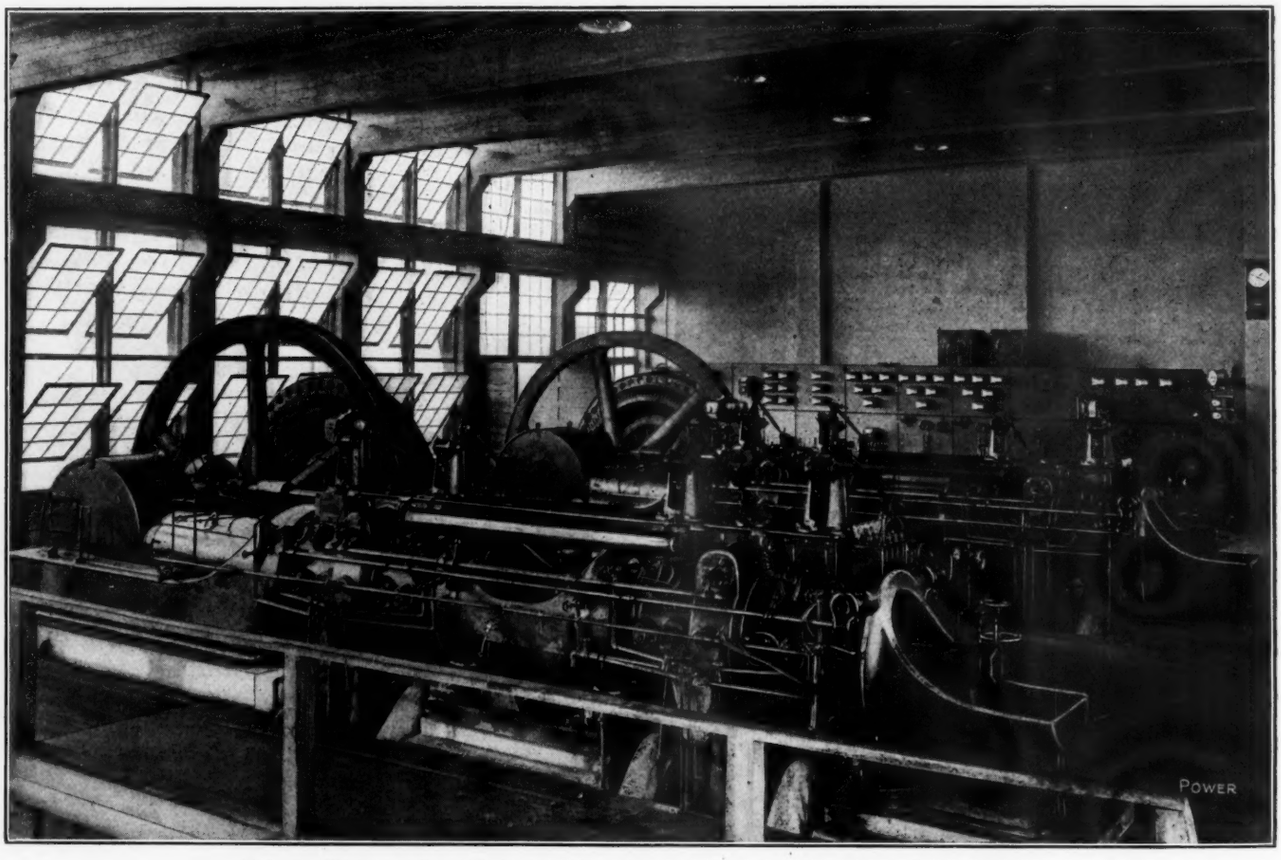


FIG. 1. VIEW IN THE ENGINE ROOM OF THE WARE COUNTY LIGHT & POWER CO.

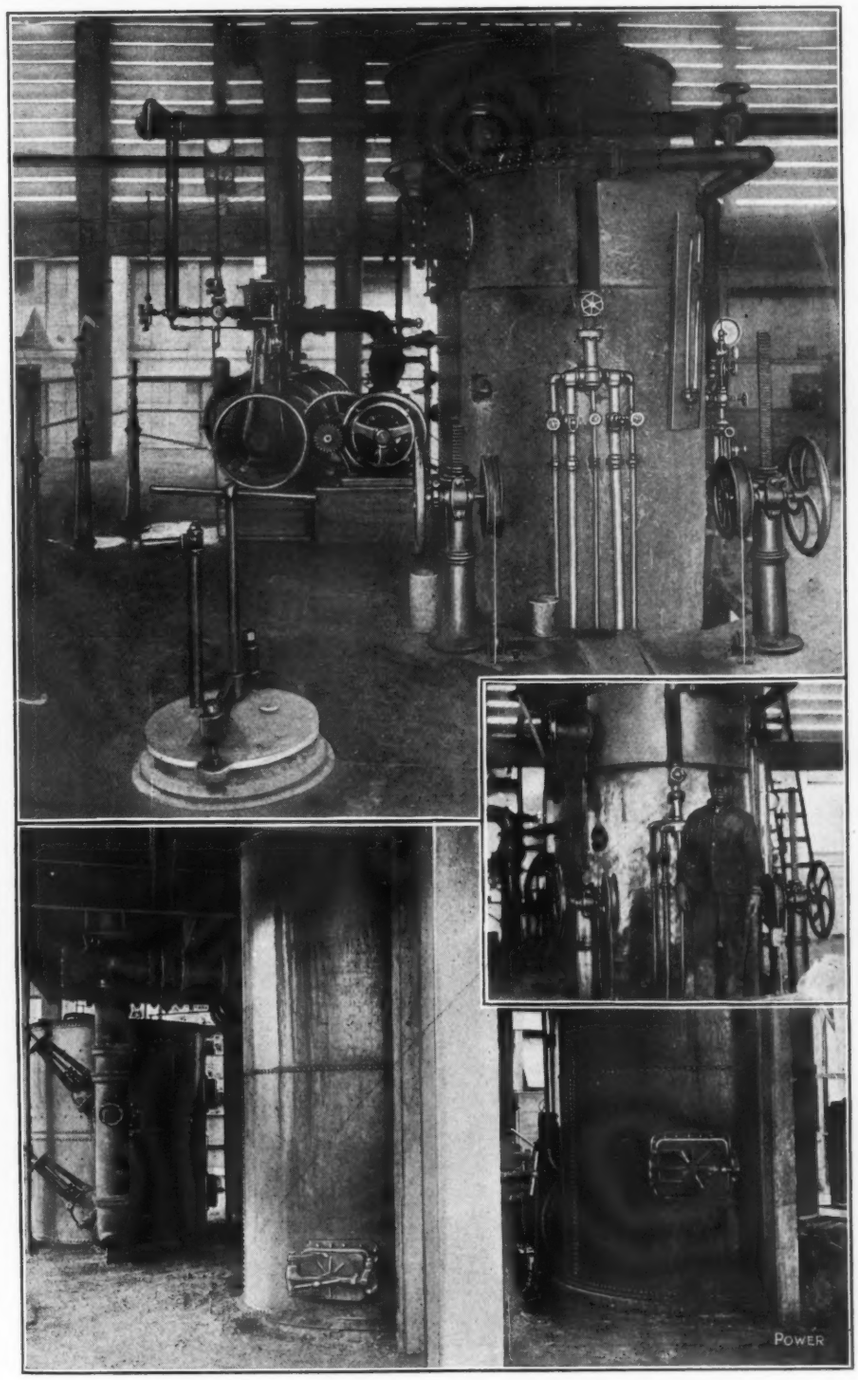
THE LIGHTING AND POWER PLANT

The gas-producer division of the plant is equipped with a 1000-hp. Loomis-Pettibone down-draft producer and a 750-hp. outfit of the same type. Each producer consists of the usual arrangement of twin generators serving through one wet scrubber and one dry purifier, and subjected to draft by a steam-driven exhauster. These make gas for two Allis-Chalmers tandem double-acting engines of 340 hp. each, running at 200 r.p.m. The engine cylinders are 18 in. in diameter and the stroke is 24 in. Each engine is direct-coupled to a three-phase alternator rated at 250 kilovolt-amperes and delivering its output at 2300 volts and 60 cycles. Each alternator has its individual exciter, belt-driven from a pulley on the main shaft between the engine frame and the alternator. There is also a motor-generator set as a reserve to be used in case of accident to either of the belt-driven exciters. This form of reserve unit for excitation was adopted because of the quickness with which it can be put into service.

Fig. 1 is a view in the gas-engine room and Figs. 2 and 3 are views of the producer charging floor; the latter picture illustrates very effectively the class of engineering talent that is available for operating power plants in this vicinity. Figs. 4 and 5 show portions of the producer cleaning floor.

The engine room is planned for the future installation of two more generating units similar to those now in service, and the producer equipment was installed with this ultimate capacity in view.

The exhaust gases from the engines pass through Riblet heaters which are located just outside the building, as shown in Fig. 6. The reason for this location was that it permitted the exhaust pipes of the engines to lead in a straight horizontal line from the engines to the heaters, thereby avoiding bends and intermediate pockets. The water heated by the exhaust gases is used for feeding the boilers of the steam plant and the economizers of the producer equipment. The location of the heaters out in the open air seems odd until one remembers that the climate is a mild one in winter and very warm during the remainder of the year. Moreover, the ice machines are not operated during the coldest part of the year and the water heated by exhaust gases is then only the relatively small quantity required by the economizers of the producer plant. Consequently, there is ample heat, even in the coldest weather which occurs down here.



FIGS. 2, 3, 4 AND 5. THE GAS PRODUCERS AND AN "ENGINEER"

The pine slabs and scrap used in the producers have a heat value of about 6700 B.t.u. per pound, as charged. The wood contains a considerable quantity of water, which, of course, reduces its heat value per pound much below what it would be with dry wood of the same quality. Thus far, however, the plant is lightly loaded, even during peaks, so that it would not be worth while to dry the wood before using it in the producer. The producer is cleaned once every six weeks.

During a recent run of 210 hours, close records were kept of the performance of the gas plant, which showed the results stated in the accompanying table. In considering the fuel consumption shown by the table it must be remembered that the engine in service operated with an average load factor of 34 per cent. and the generator with a power factor of 60 per cent. during three-fourths of each 24-hour day and the load factor during the remainder of each day was only 73 per cent. and the power factor 80 per cent. Under these conditions no apology is required for the producer ef-

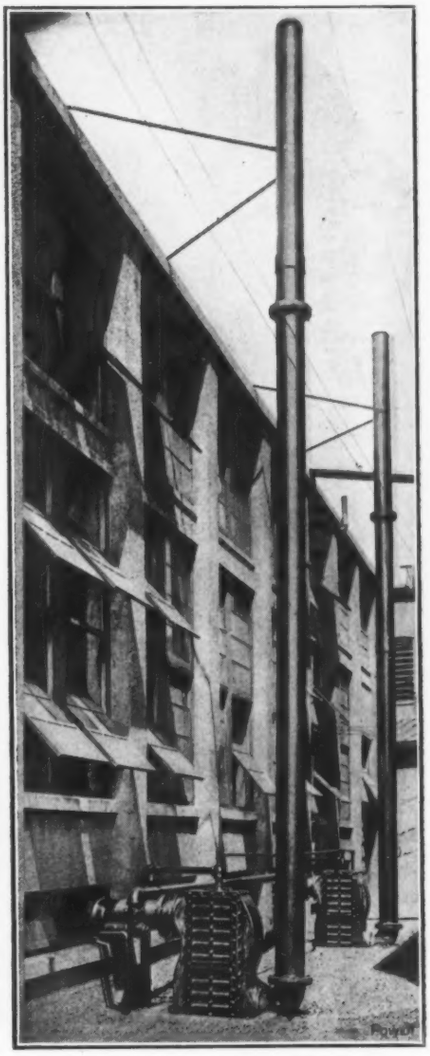


FIG. 6. EXHAUST HEATERS

ficiency of 69½ per cent. and the 14 per cent. thermodynamic efficiency of the generating unit. During a two-hour peak of 210 kw. load, the engine took 73,130 cu.ft. of gas, aggregating 6,581,700 B.t.u., showing a consumption of 15,671 B.t.u. per kilowatt-hour, or about 10,525 B.t.u. per brake horsepower-hour, accrediting the alternator with an efficiency of 90 per cent., which it probably did not have, taking into consideration the power required by the exciter. The gas made when firing wood shows about the following analysis:

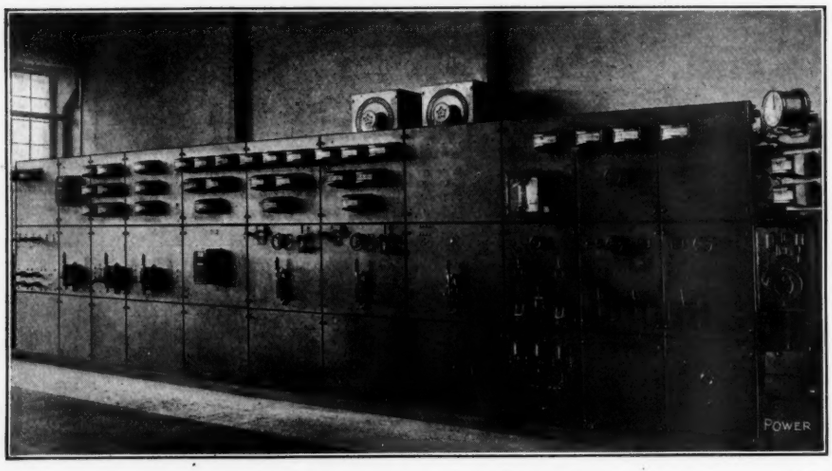


FIG. 7. THE POWER HOUSE SWITCHBOARD

RESULTS OF A 10-DAY GAS-POWER RUN

Duration of recorded performance, hours	210
Total kilowatt-hours	21,280
Average load: day, 85 kw.; night, 183 kw.; overall	101.3
Total pounds of wood	120,300
Total cubic feet of gas made	5,770,900
Cubic feet of gas per pound of wood	48
Average B.t.u. per cubic foot (low)	90
Average B.t.u. per cubic foot (high)	97
Total B.t.u. delivered to engines (low)	519,381,000
B.t.u. per kilowatt-hour, average	24,400
Generating efficiency, per cent.	14
B.t.u. (high) in gas per pound of wood fired	4,653
B.t.u. (high) in wood per pound, as charged	6,700
Producer efficiency, per cent.	69½
Average power factor:	
Day	69%
Night	80%

CO	13.6%
H	12.75
CH_4	1.85
CO_2	12.00
O	0.40
N	59.40

By calculation, the low heat value is 101½ B.t.u. per cubic foot, reduced to 32 deg. temperature; the calorimeter values at the average temperature during the 210-hour run just reported were 90 low and 97 high.

THE ICE PLANT

The ice-making division of the plant comprises three return-tubular boilers rated at 150 hp. each, one 75-ton York compressor, one 30-ton Wolf compressor and a 6-ton Frick compressor, with the usual auxiliary equipment for making block ice. The boilers are equipped with furnaces of the dutch-oven type which are arranged so that they can be fired with either wood or coal, but are commonly fired with wood refuse. The two larger compressors are of the usual steam-driven types; Fig. 8 shows the York machine. The little Frick machine, however, is driven by a three-phase motor, because it is used only during the winter months when the steam plant is shut down.

From about Mar. 1 to Nov. 1, the steam-driven compressors are operated at full load and a storage house of 2000 tons capacity is gradually filled, in addition to the regular sale of ice locally and for icing refrigerator cars (this latter business disposes of 4000 to 5000 per season).

On Nov. 1 the ice-making equipment is shut down entirely and the 6-ton Frick machine is put into service to keep the temperature down in the storage house. The car-icing season is practically over then and the 2000 tons in storage fill the winter demand. On Mar. 1, the steam-driven compressors are started up again and the motor-driven machine is shut down until needed. It constitutes a modest excess-demand unit for emergency use at the height of the season, besides refrigerating the storage house in winter.

Running at full load, about 10 per cent. of make-up water is required in the ice-making system. It is the usual one in which the exhaust steam from the power cylinders of the compressors is condensed at atmospheric pressure, the condensate boiled again and filtered into the tanks.

The plant is operated under the very competent supervision of Mr. B. Loomis, Jr., to whom I am indebted for the foregoing information.

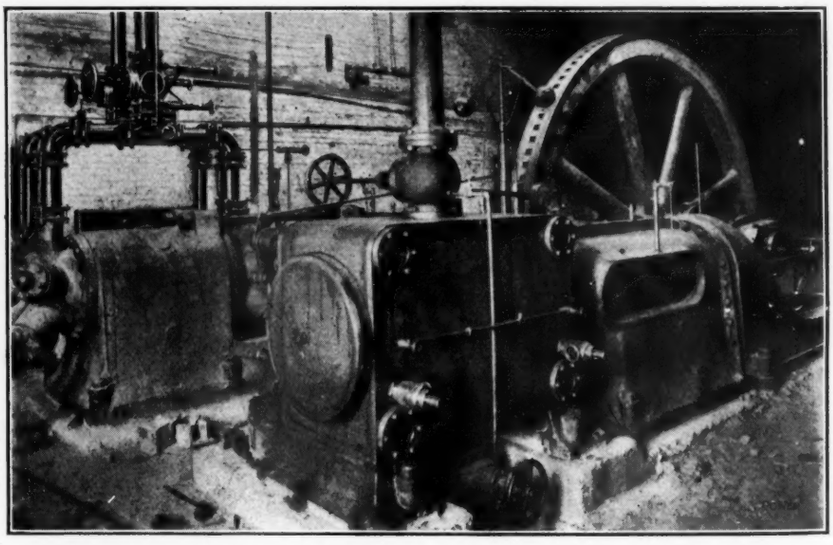


FIG. 8. THE LARGER ICE-MAKING MACHINE

Increase in Turbine Efficiency

The increase in turbine efficiency has been rapid and striking. A Parsons turbine of 4 kw. power, built in 1885, using saturated steam and working noncondensing, used 200 lb. of steam per kilowatt-hour. Another unit of 75 kw., built in 1888, using saturated steam of 100 lb. pressure and working noncondensing, required 55 lb. of steam per kilowatt-hour. Another turbo-generator of 100 kw. capacity, built in 1892 and using a condenser, brought the steam consumption down to 27 lb. per kilowatt-hour. A 1250-kw. turbo-generator, built in 1900, working with a condenser, lowered the consumption to 18.22 lb. per kilowatt-hour, and a 5000-hp. unit, in 1910, using 200 lb. of steam and 120 deg. of superheat, with a vacuum of 28.8, has reduced the consumption to 13.2 lb. per kilowatt-hour.—*Scientific American.*

Drainage Power Plant at New Orleans

By Cecil P. Poole

An uptodate central station, supplying about 5000 hp. to several pumping stations employing mostly synchronous motors to drive the pumps.

The low level of the city made this power drainage system necessary.

Because of the low level of the city of New Orleans with respect to the Mississippi River and neighboring lakes, the surface water deposited in the streets by rains cannot be disposed of by gravity. Therefore, a power drainage system was installed several years ago and this has been extended from time to time until now the power applied to the removal of water from the streets during a healthy thunder shower would be sufficient to operate the central station of a good-sized flourishing city. When everything is going at full load, the aggregate load on the system is about 5000 hp.

The drainage system consists broadly of a number of subterranean canals or conduits interconnected and opening into the near-by lakes, pumping stations containing large centrifugal and screw pumps, most of them driven by alternating-current motors, and a central power station equipped with steam-driven generating units which supply current to the pump motors.

FIG. 1. CENTRAL POWER STATION OF THE NEW ORLEANS DRAINAGE SYSTEM

CENTRAL POWER STATION

The central power station is 182 ft. long and 140 ft. wide and houses Babcock & Wilcox boilers aggregating 2300 rated horsepower and Heine boilers aggregating 1100 rated horsepower, together with the usual auxiliaries; three cross-compound engines, each direct-connected to a 750-kw. three-phase alternator, another connected to a 1000-kw. alternator, a fifth cross-compound connected to a 375-kw. machine and two little tandem compounds each driving a 75-kw. generator. The exciter equipment comprises two 10-kw. steam-driven units and two 50-kw. motor-generator units, the motors of which are of the induction type. Fig. 1 is a view in the generator room of the power station. All of the engines are Allis except that of the 1000-kw. unit, which is a Rice & Sargent. All of the generators are of General Electric make.

The boilers are equipped with oil burners, as shown in Fig. 2, which utilize either crude petroleum or oil refinery waste products. Fig. 3 shows a sectional elevation and a cross-section of a burner, which is obviously of very simple construction. Oil is fed to the burners by two small steam pumps supplied from storage tanks into which it is pumped from the railroad tank cars in which it is delivered. No air is delivered through the burner; all of the air for combustion enters the furnace, which is of the dutch-oven type, from beneath, through ducts the entrances to which are controlled by dampers. Steam enters the mixing chamber through the central hole opposite the oil nozzle along with the oil and also enters through a hole above and one below the main jet, thereby maintaining ample pressure in the mixing chamber to give a good strong blast of mixed oil and steam out of the burner nozzle.

Crude oils from the Texas and Louisiana fields have been burned with these outfits; also refinery fuel oils, or petroleum from which the kerosene and lighter products have been distilled. This residue has an asphaltum base, but no difficulty has been experienced on that account. Without any special preparation or "tuning up," the boilers show an evaporation of 15 lb. of water, from and at 212 deg., per pound of oil or distillery residue; the heat value of the fuel ranges from 18,500 to 19,400 B.t.u. per pound of oil.

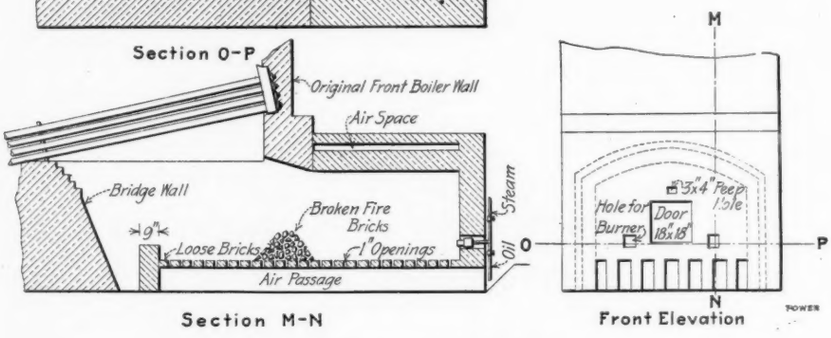


FIG. 2. BOILER FURNACE FOR BURNING OIL

The feed water for the boilers is obtained from artesian wells about 800 ft. deep. The water rises to within 25 ft. of the ground surface and is "lifted" from there to the boiler room by means of compressed air. It is excellent for boiler purposes, containing no material which forms hard scale; the principal matter in solution is carbonate of soda. On this account a general cleansing of the boilers is very seldom necessary; each boiler is simply emptied and refilled at intervals of about three or four weeks, because the water is alkaline and gradually becomes concentrated, but blowing out soft scale or sludge is very rarely necessary.

PUMPING STATIONS

There are now in operation seven pumping stations and an eighth will be built in the future. The accompanying map of the drainage system, Fig. 4, will serve to clarify the references to the locations of the pumping stations and their interrelations. Station No. 4 is the one that has not yet been built.

In most of the pumping stations the main pumps are set in pits, with the runners submerged, and are connected to their motors by vertical shafts, as indicated in Figs. 5 and 7. In the others, the pump shafts are horizontal and each entire pumping unit is mounted on the station floor level, as shown in Fig. 6.

Pumping station No. 1 is of the former class; it is a vertical section of this station that is shown in Fig. 5. The station contains at present three screw pumps, each driven by a 266-hp. synchronous motor and designed for moving 15,000 cu.ft. of water per minute with a 5-ft. lift from the level of the suction basin to that of the discharge basin;

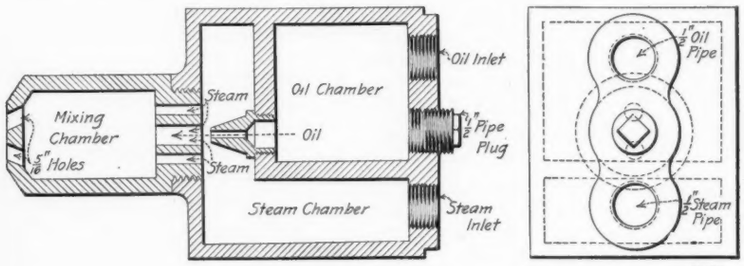


FIG. 3. ONE OF THE OIL BURNERS

also a little centrifugal pump rated at 2400 cu.ft. per minute, which is driven by a 150-hp. induction motor and is used for removing the dry-weather water. Station No. 2, located at Broad and St. Louis Sts., is similar in all respects to station No. 1 except that it is equipped with two large screw pumps instead of three. It drains the area bounded by the two navigation canals, the Mississippi River and Broad St.

Pumping station No. 3, located at Broad St. and London Ave., at present contains three centrifugal pumps, of which two are driven by 400-hp. synchronous motors and are capable of moving 15,000 cu.ft. of water each per minute, with an 8-ft. lift, and the third is

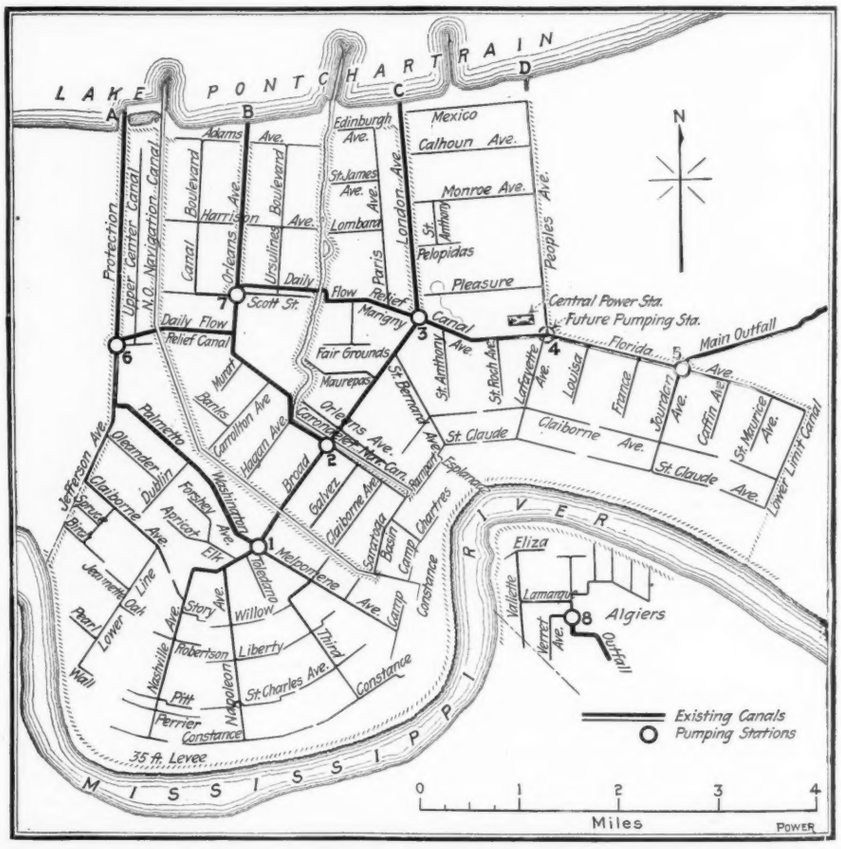


FIG. 4. MAP OF NEW ORLEANS DRAINAGE SYSTEM

rated at 3000 cu.ft. per minute with a lift of 12 ft.; this one is driven by a 120-hp. induction motor. These pumps all have horizontal shafts and are located on the floor level of the station, as shown in Fig. 6, which is a sectional elevation of this station. The pumps are primed by means of a small vacuum pump, driven by a direct-current motor, after they have been brought up to normal speed and the starting compensators are cut out. This arrangement makes it very easy to start the pumps and accelerate their motors to synchronism; moreover, no gates are necessary in the intake and discharge pipes, because these are drained by gravity as soon as the pumps are shut down.

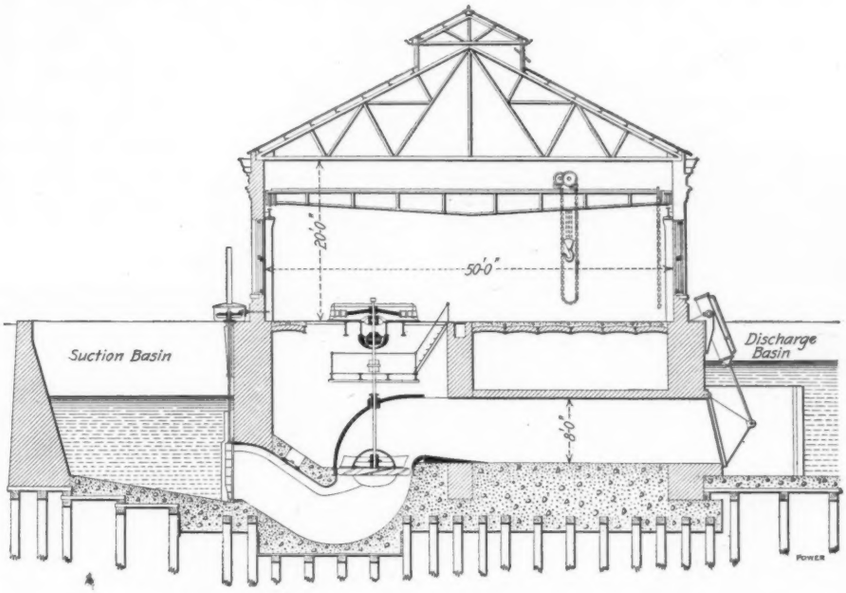


FIG. 5. SECTION THROUGH PUMPING STATION NO. 1

The pumps in station No. 5 were originally driven by 400-hp. vertical triple-expansion engines, but when station No. 8 (in Algiers, across the river from New Orleans proper) was added to the system one of the engines was transferred to that station and a 333-hp. synchronous motor was installed in its place. Station No. 5 therefore contains now one pump direct-connected to the remaining steam engine and one electrically driven. The steam unit is not used except in cases when abnormal rains carry the load beyond the capacity of the motor-driven pump. The pumps have horizontal shafts and are located on the station floor level as in station No. 3. Each one is capable of moving 9000 cu.ft. of water per minute, with a lift of 12 ft. They are of the double-suction centrifugal type.

Station No. 6 is the largest one of the system. The present equipment consists of four centrifugal pumps, each capable of moving 15,000 cu.ft. of water per minute with a lift of 10 ft. and one rated at 1800 cu.ft. per minute with a lift of 13½ ft.; all of these pumps are of the vertical-shaft submerged type. The large ones are driven each by a 466-hp. synchronous motor. Each intake and discharge pipe is provided with an 8-ft. sluice gate operated by a small electric motor and each discharge pipe is also provided with a flap gate (see Fig. 5) which acts as a check valve and closes the outlet when the pump is shut down. This, obviously, prevents the backing up of water from the discharge basin when the pump is idle and thereby avoids the possibility of having to pump the same water twice. The smaller pump is driven by a 100-hp. induction motor. Station No. 7, located at Orleans St. and Taylor Ave., is exactly like No. 6 except that it contains three pumps instead of four.

Station No. 8, in Algiers, contains one centrifugal pump of the horizontal-shaft type, driven by the triple-expansion steam engine which was removed from station No. 5. The pump is rated at 9000 cu.ft. per minute and the engine at 400 hp.

STARTING THE SYNCHRONOUS MOTOR PUMPS

Those motors which are located on the station floor levels are readily started, brought up to synchronism and thrown into service, because the runners are not submerged and the motors can be started with the pumps empty and brought up to synchronism with practically the same facility that characterizes starting a motor entirely disconnected from its load. After attaining normal speed the load is applied by priming the pumps by means of small pumps driven by induction motors.

With the submerged pumps the starting and acceleration of the motors are much more troublesome, because a synchronous motor will not start with a load; its torque, starting inductively, is too feeble. Therefore, it is necessary either to empty the pumps of water and start in the same way as with the floor-level pumps or else to slow down the generators at the central station until the frequency is low enough to pick up the motor with its load on and then accelerate up to normal frequency.

This latter method is the one now used, the starting of a motor, or of all the machines in a station, being accomplished by connecting up to a single generating unit at the central power station, through busbars separate from the general system. The generating unit is slowed down until the frequency is about 15 cycles, the motor switch is closed and the machine brought up to the gen-

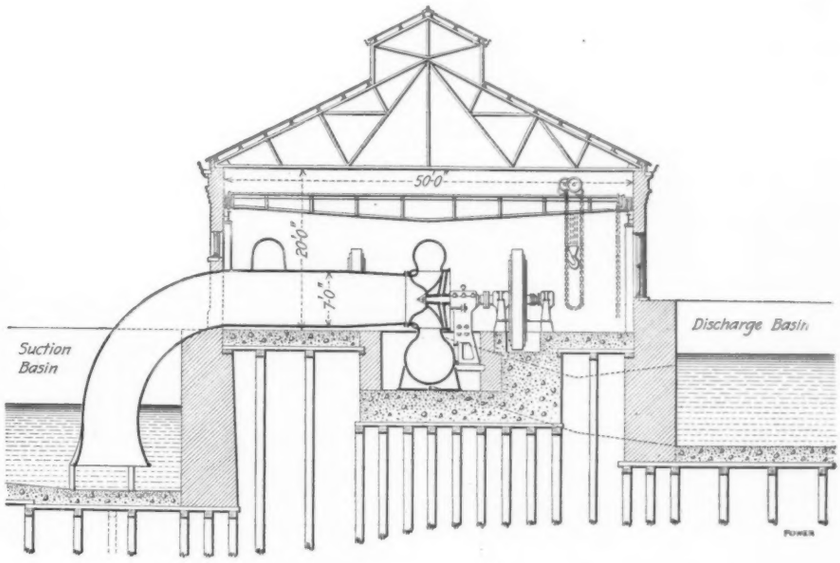


FIG. 6. SECTION THROUGH PUMPING STATION NO. 3

erator frequency without the compensator commonly used for starting without load. Then the generating unit is gradually accelerated to the normal speed, carrying the motor along with it. When normal frequency has been attained the generator is shifted over to the regular running busbars and the extra busbars are free for starting another motor or group of motors with another generating unit.

FIG. 7. INTERIOR OF STATION 7

This method has grown to be rather unwieldy with the growth of the pumping equipment, and arrangements are under way for installing small pumps and induction motors to be used for pumping the water out of the housings of the submerged pumps and thereby allowing them to be started up free, at normal frequency, as the elevated pumps are now started.

Ten more pumps are to be added to the system in the immediate future, each to have a capacity of 30,000 cu.ft. per minute. All of these will be of the horizontal-shaft form, located above water level, and the motors will be started at normal frequency with the pump runners empty.

TRANSMISSION LINES

Each pumping station except No. 8 is connected to the central power station by means of two distinct feeders, and each feeder is protected by an ample equipment of multigap lightning arresters, located about half a mile apart. The lines are supported on cypress poles set 9 ft. into the ground and projecting as short a distance above ground as possible without interference with street traffic. No transformers are used between the central station and the pumping-station busbars. The generators deliver three-phase currents at 3300 volts and the motors are supplied directly at that voltage.

Power from a Small Low-Head Stream

BY S. RICE

The Athens Ry. & Electric Co., of Athens, Ga., operates three hydro-electric plants on the Oconee River, located respectively at Mitchell's Bridge, Tallassee Shoals and Barnett Shoals, aggregating in capacity 5200 kw.; also a steam-turbine auxiliary station of 1500 kw. capacity located in the city of Athens. The latest of these installations is the plant at Barnett Shoals, Fig. 1, which has recently been put in service. It was built by the James White Power Co. and leased to the above named public-service corporation for 99 years.

In this plant, which was designed for a net effective head of 50 ft., the most modern features of construction for utilizing the full available power of the stream have been embodied. It is, in fact, an excellent example of the possibilities of power generation to be developed by good engineering from the flow of a small stream with only a moderate head.

FIG. 8. TEST AT STATION 1; ONE PUMP DELIVERING 15,000 CU.FT. PER MINUTE

Fig. 2 is a plan of the station and Fig. 3 is a longitudinal section through one of the generating units. The four hydraulic turbines are of the twin-runner, horizontal open-flume type, with center-discharge casings. Each is rated at 1200 b.hp. when running at 360 r.p.m., under a

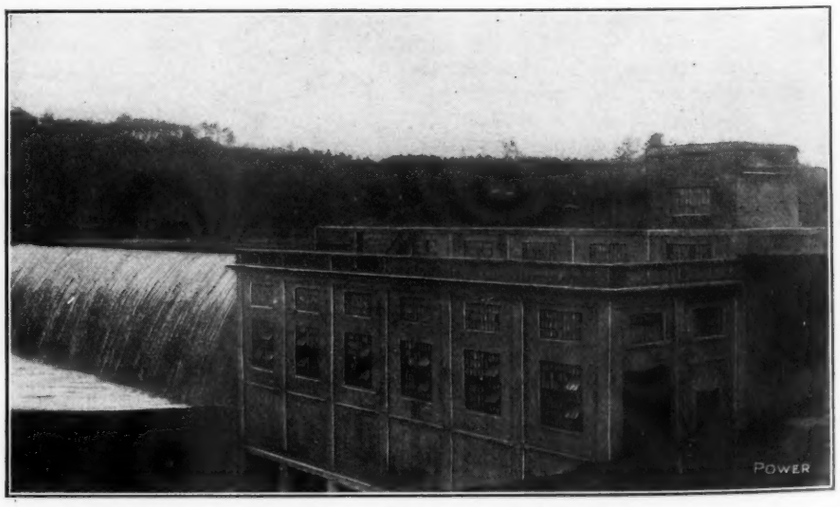


FIG. 1. BARNETT SHOALS POWER HOUSE OF THE ATHENS RY. & ELECTRIC CO.

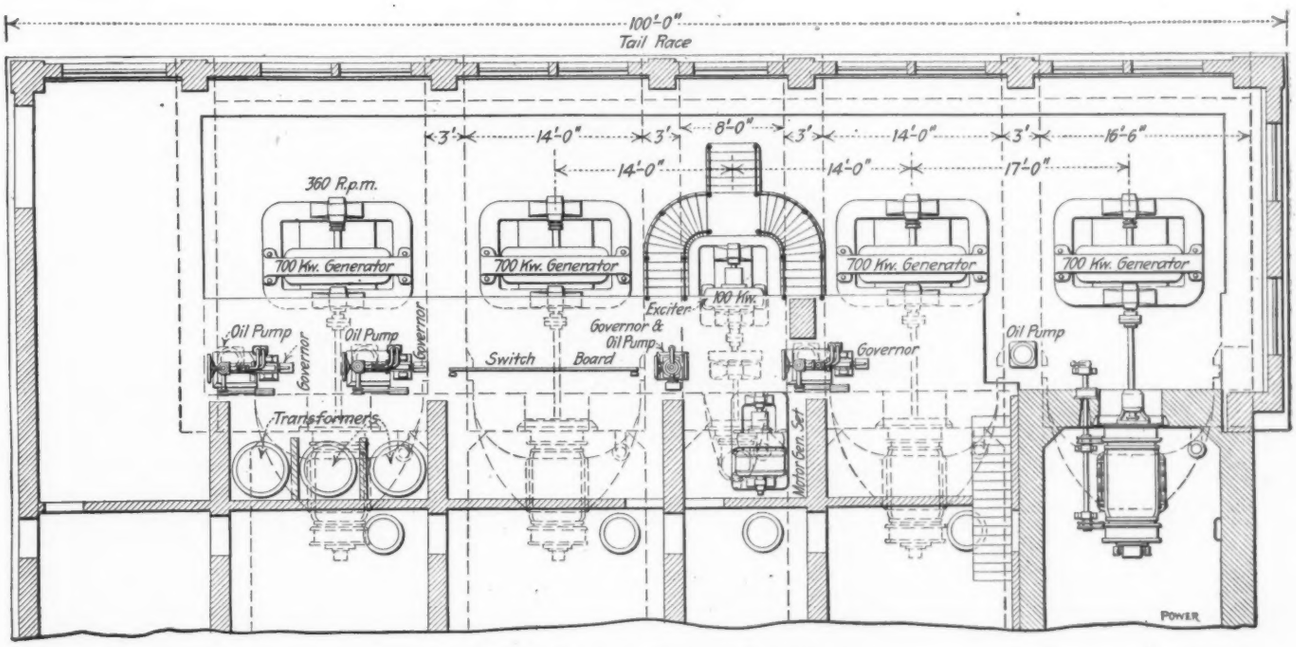


FIG. 2. GENERAL PLAN OF STATION

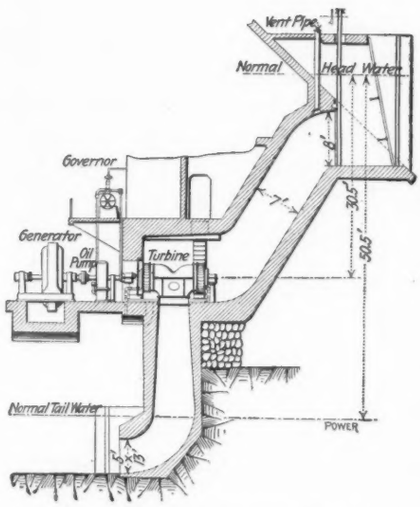


FIG. 3. SECTION THROUGH PLANT

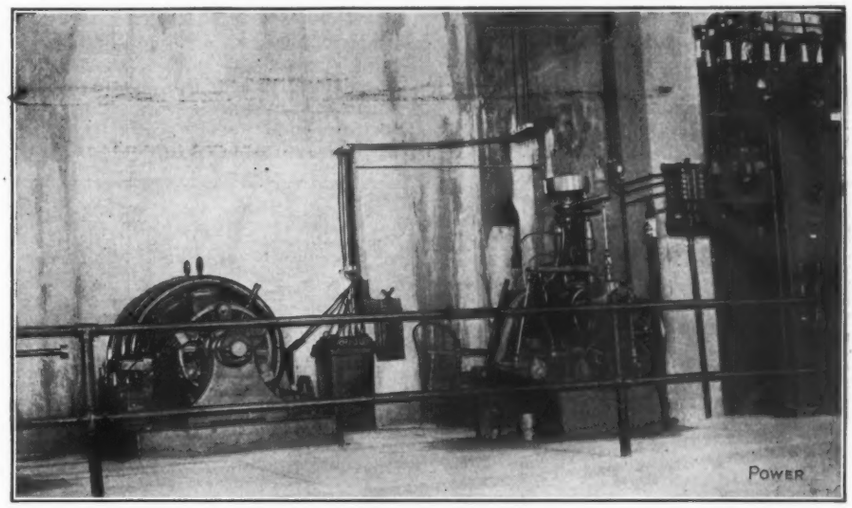


FIG. 6. SELF-CONTAINED GOVERNOR FOR EXCITER TURBINE

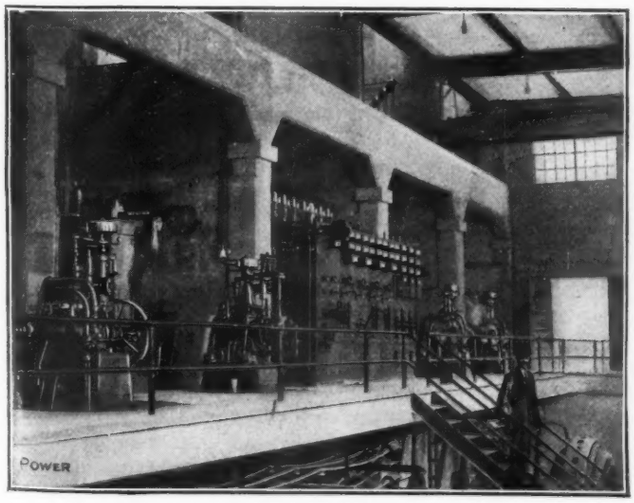


FIG. 4. OIL-PRESSURE GOVERNORS AND SWITCHBOARD

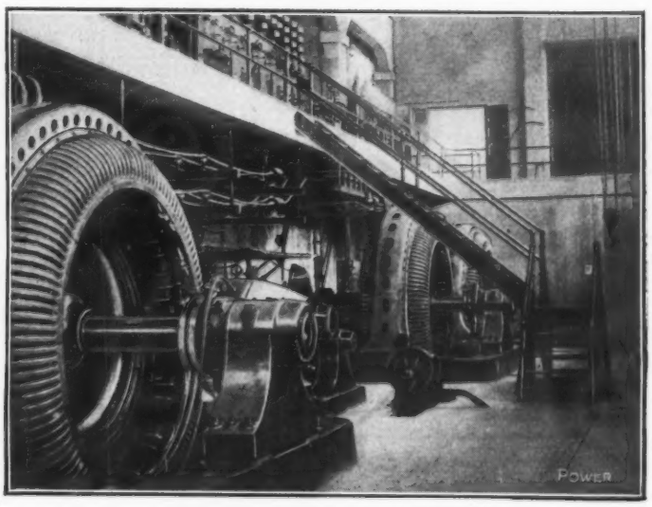


FIG. 5. MAIN GENERATORS

50-ft. head, and is direct connected to a three-phase, 60-cycle, 12,000-volt generator of 700 kw. normal capacity.

The governors for these turbines, Fig. 4, are of the oil-pressure type, each consisting of a stand with fly-balls, relay and regulating valve and also a regulating cylinder, together with a separate rotary gear-type oil-pressure pump. The pressure tank is mounted directly on top of the pump housing. These governors operate with the open oil system; that is, after it is used in the regulating cylinder, the oil is returned to an open receiving tank, where it has a chance to settle and clarify before returning to the rotary pump and pressure tank.

There are two exciter units, each of 100 kw. capacity, furnishing direct current at 120 volts. One of these, used for starting, is driven by a direct-connected hydraulic turbine of the single-runner, horizontal, quarter-turn-discharge type, rated at 210 b.hp. Its governor is also of the oil-pressure type; but in this case the rotary pump, regulating cylinder and fly-ball stand are all included in one self-contained unit. The second exciter, of similar characteristics, is driven by an induction motor. This also appears in Fig. 6.

The outgoing three-phase lines to Athens are provided with protective devices consisting of choke coils, aluminum lightning-arresters with horn-gap disconnecting switches, and other apparatus.

In the generating plant there is also a substation for an industrial power circuit. This includes the three 12,000/2300-volt oil-insulated, self-cooled transformers.

The Athens Ry. & Electric Co., in addition to its traction and lighting load, furnishes power for motor drive in a number of large textile mills and other manufacturing establishments, one cotton spinning plant being located near the power site. The operation is in charge of C. D. Flanigen, second vice-president and chief engineer, and C. L. Proctor is superintendent.

The Causes of Boiler Explosions

By S. F. Jeter*

A paper delivered before the American Boiler Manufacturers' Association at New Orleans, Mar. 12 to 15. The chief causes of boiler explosions are assigned as poor design and carelessness in operation. These are considered somewhat in detail, together with recommendations tending to reduce the number of explosions.

*Supervising inspector, Hartford Steam Boiler Inspection & Insurance Co.

Broadly speaking, there is one explanation for all boiler explosions; namely, the boiler or some part of it is too weak to withstand the stress brought upon it. There are many causes contributing to such weakness, and a definite cause can usually be given for most explosions.

Public opinion is being aroused to the fact that many boiler explosions are preventable, as evidenced by the present agitation for laws governing the construction and operation of boilers. The lead of the city of Philadelphia has been followed and improved upon by the state of Massachusetts; also Ohio and several municipal governments now have boiler laws patterned after those of Massachusetts, and similar action is being considered seriously by a number of other states and cities.

Faulty Design

One cause of boiler explosions is faulty design, as they are frequently constructed too weak for the pressure to be carried. This does not mean that the boiler will necessarily explode as soon as the pressure is raised. Explosions from this cause usually occur after years of use, the overload on the parts having had time to gradually weaken them until they are no longer capable of resisting the excessive strain.

Of course, a manufacturer has practically no control over the steam pressure to be used on a boiler, after it has been delivered to the purchaser. But if the manufacturer should stamp his name and the safe working pressure for which it was designed on each boiler built, it would act as a protection to his reputation in the event of excessive pressure being used. Proper inspection and fixing of pressures by experts is the logical remedy for explosions due to this cause.

A fault of design which often leads to an explosion is the adoption of a shape which tends to deform under pressure. In such cases, if the movement produced occurs within narrow limits along fixed lines, grooving or cracking is almost certain to occur, finally resulting in an explosion, unless the defect is discovered before the structure has been weakened to the breaking point. The obvious remedy is to use shapes which the internal pressure does not tend to change, and if this is impractical, to use such forms that the movement produced will occur over considerable areas and not be confined to narrow limits.

Improper reinforcement of openings has occasionally been the cause of boiler explosions. If the openings in boiler work were not generally of such moderate dimensions, this might be a more frequent cause of disaster. No definite information is available regarding the distribution of stresses around an opening in a cylinder when subjected to internal pressure; consequently, the design for the reinforcement of such openings is by rule-of-thumb.

Another fact responsible for many explosions is an arrangement not permitting of accessibility for the inspection of all parts. This is especially so when the inaccessible parts are located where rapid deterioration is likely to occur. No portion of the boiler proper should rest directly on a foundation or have any of its parts buried in earth or ashes. Furthermore, a design which does not permit free circulation of water in all of its parts is liable to produce rapid internal corrosion, for unless a current is produced by the circulation sufficiently strong to remove all bubbles of air that may attach themselves to the surfaces, rapid corrosion is almost certain to ensue. This, if neglected, may result in an explosion.

Air which is a mixture of about four parts of nitrogen to one of oxygen, together with very small quantities of other gases, dissolves to a certain extent in water. However, the oxygen, being more soluble than the nitrogen, dissolves more readily and the proportion of the gases found dissolved in the water is roughly one of oxygen to two of nitrogen, instead of in the proportions found in the air. When the dissolved air is liberated by the heat, the high percentage of oxygen causes the surfaces on which the bubbles may collect, to be rapidly corroded. This accounts for the severe corrosion of vessels containing water which is merely heated without a strong circulation being produced.

A correct boiler design will provide uniform flexibility throughout. A stiff, rigid part next to one which is flexible is a menace to safety if there is any tendency toward movement between the parts, either due to temperature changes or pressure.

Poor Workmanship

Defective workmanship is responsible for some explosions, the barbarous practice of drifting rivet holes having doubtless contributed largely in the past to such accidents. The reputable manufacturer of today, however, will not knowingly permit such work.

Failure to properly flare the tubes and nipples in water-tube boilers has frequently resulted in explosions. The safety of the joint between a tube and a plate when expanded and flared or merely expanded, is not a question of the relative strength of such connections newly made. When, for some reason connected with

the operation of a boiler, a connection of this kind becomes loose due to a movement of the parts from expansion or vibration, together with the excessive weight sometimes sustained, the tube or nipple with a flared end is decidedly more safe than one which is merely expanded. The flared nipple usually gives warning of its looseness by leakage before it pulls out.

Defective Material

Defective material is sometimes the cause of boiler explosions, and the boiler manufacturer is largely dependent upon the producer of the material for protection in this respect. Nothing but material of the best quality should be specified for all parts of a boiler which are called upon to resist the stresses produced by the pressure of steam, and every precaution should be exercised to see that such material is obtained. Cast iron should never be used in any part of a boiler called upon to resist tensile stress.

Willful Neglect

A cause of explosion which is particularly reprehensible, because of its being preventable, is due to an owner's willingness to pit his judgment against more competent or conservative advice. Often boilers are known to be in need of repairs, but the work is put off to a more convenient season. A feed pump refuses to start, and instead of fires being drawn as soon as the water reaches the lowest safe level, a chance is taken that it can be run a little longer. Pressures are sometimes carried higher than reasonable safety would permit, to avoid the expense of larger engines, or better boilers. Boilers are forced beyond a reasonable duty for the heating surface they contain. This is a feature that must be reckoned with more in the future than it has been in the past.

Neglect or Careless Operation

Boiler explosions are also the result of neglect or carelessness in operation. Scale and deposit are often allowed to collect in quantities that are dangerous; connections to water columns are allowed to become stopped; oil is permitted to enter the boiler with the feed water; repairs to settings which may affect the safety of the boiler are neglected; safety valves are not regularly tested to ascertain if they are in operating condition; or occasionally an owner who discovers the safety valve leaking, with an eye blind to every consideration except the prevention of loss of steam, places a stop valve on the connection to the safety valve or plugs the outlet. A steam gage may register incorrectly and the engineer screws down on the safety valve in an endeavor to make the gage show the correct pressure.

Again, the steam pressure may not be sufficient to produce the results desired and the safety valve is deliberately made inoperative to overcome the difficulty. All of these conditions have been the cause of boiler explosions in the past and they probably will continue to contribute their share in the future until the steam user is more thoroughly educated in the matter of the risk he runs by such carelessness.

Tube Failures

Tube failures, which are chiefly confined to the water-tube type of boiler, are a source of grave concern to the boiler-insurance interest because it is difficult to guard against the usual failure of this kind by inspection. A defective weld usually does not show on the surface of the tube, and even where the surface indications would lead to suspicion, a large percentage of the tubes in water-tube boilers are beyond the reach or vision of the inspector. The thorough inspection of tubes before they are placed in the boiler, while very unsatisfactory, even taken in connection with the mill test, is about the only protection possible against accidents due to this cause.

The seamless tube will prevent accidents due to defective welding, but tubes made by this process are not always of uniform thickness, and with the cold-drawn product there are apparently internal strains produced by the process of manufacture which sometimes cause the tubes to break when merely heated. If cold-drawn tubes are used for boiler purposes, the annealed stock should be obtained. Hot-drawn seamless tubes are now meeting with considerable favor among engineers for boiler purposes.

A considerable percentage of tube failures occur without the slightest evidence as to their cause. A welded tube frequently breaks through the solid metal away from the weld, without being corroded or weakened in any way that may be detected by the eye, and without evidences of overheating. There must be some reason for such failures.

It is a fact that while pressures and rates of driving have been remarkably increased during the past 15 or 20 years, no increase in the thickness or strength of tubes has occurred. That the thicker tube is safer seems to have been demonstrated by a number of cases where heavy tubes have been used in place of those of standard gage, and tube troubles have ceased. Of course, it can be contended that the theoretical factor of safety is higher on tubes even of standard thickness than on almost any other portion of the boiler. However, under operating conditions accompanying high rates of driving, is it not possible that there are decided fluctuations in the temperature of the material in the tubes? The rapid formation of steam bubbles removes for a certain interval of time the water protection from the inner surface of a tube, and the thinner the material, the higher will its temperature rise during a given time in which it is not protected. It is conceivable that the structure of the metal in a thin tube may be affected in time by this constant change in temperature until it gives out, while the thicker tube might not be affected to the same extent by this means. This idea is only advanced as a possible explanation for some of the tube accidents which seem to defy definite causes being assigned for them.

The thicker material in the case of welded tubes will make it more certain that the required strength is obtained in the weld; also, surface imperfections in the material would not affect the strength to the same degree in the thick tube as it would in the lighter one.

The importance of the question of tube failures to the operator of boilers as well as to the insurance interest can be appreciated when it is realized that the toll of loss of life and limb exacted by such failures probably exceeds other classes of boiler accidents when the relative number of fire-tube and water-tube boilers in use is considered.

Other Causes

Corrosion has been the cause of many serious explosions, but with boilers built accessible for inspection, explosions from this cause may be reduced to a minimum where the boilers are under the care of a competent inspection service.

A source of explosions, external to the boiler itself, but which has produced very serious disasters, is the improper arrangement of steam piping. It is very dangerous indeed to attempt to connect a boiler to a steam line where the piping is arranged so that water pockets may be formed. A water-hammer is likely to result in such cases which may break the pipe connections, and this in turn may produce an explosion of the boiler itself.

Very disastrous explosions have been due to hidden cracks or so called lap-seam cracks. The cause of these defects is either the form of seam, poor material, improper shape of the joined ends of the sheet, or the abuse of the material in the process of manufacture; possibly it may be a combination of some of these causes. That the form of seam alone is not the only factor is well demonstrated by the fact that all lap seams do not fail in this manner and also that some seams of the butt-joint type have thus failed.

It is readily recognized that with every possible precaution, boiler explosions cannot be entirely eliminated, but their number may be lessened materially. A proper inquiry into all accidents of this kind by government officials qualified and clothed with ample authority would tend to reduce the number of explosions.

Large Southern Central Station

By D. J. O'Brien*

A combination steam-turbine and reciprocating-engine plant supplying commercial light and power to the city of Birmingham, Ala., also the street-railway system.

The turbines are run condensing, but the exhaust from the engines is used for heating a large section of the city.

*Chief Engineer of the Birmingham Ry. Light & Power Co.

One of the largest steam power plants in the South is that of the Birmingham Railway, Light & Power Co., at Birmingham, Ala. Besides supplying the street-railway system and the commercial light and power for the city, it also furnishes exhaust steam for heating to the business districts. The turbines in the plant, however, are run condensing, but as an abundant supply of condensing water is not available cooling towers have been employed.

Certain features of this plant were described in the Aug. 16 and Oct. 4, 1910, issues of POWER. Although these details will be largely omitted in the present description, a general outline of the installation will be included in order to acquaint the reader with the character of the plant.

The station contains 31 boilers, totaling 17,200 boiler horsepower, and generating units, both engine and turbine-driven, aggregating 30,000 hp. The services supplied consist of a 125-250-volt Edison three-wire system; a 2300-volt three-phase system supplying the arc-lighting system; a 13,200-volt transmission system, and a 600-volt direct-current railway system.

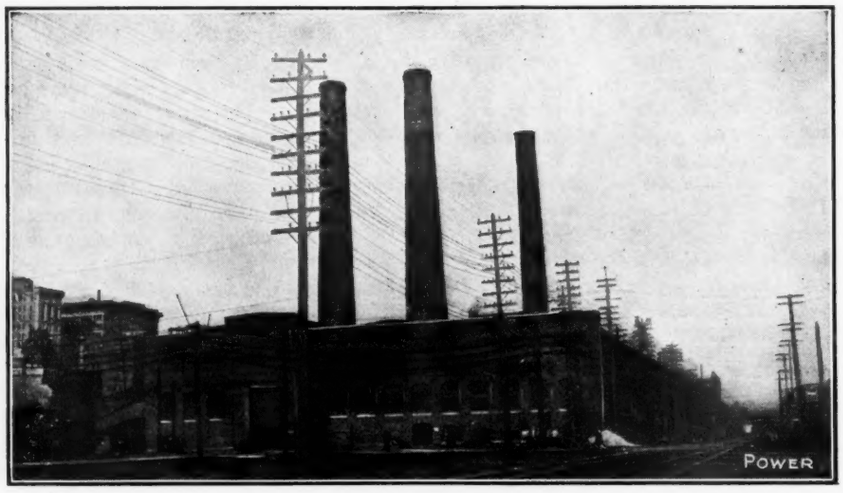


FIG. 1. EXTERIOR VIEW OF STATION

BOILERS

The boiler installation consists of twenty-four 600-hp. and seven 400-hp. Babcock & Wilcox boilers, each equipped with chain-grate stokers and fitted with wrought-iron pipe water-backs at the bridge-walls. A washed mixture of nut, pea and slack coal averaging about 13,000 B.t.u. per pound is used. This is brought to the plant in cars and dumped into concrete bins holding about six tons each. From these it is discharged to a belt conveyor about 440 ft. long which, in turn, discharges into a concrete pit holding about 20 tons. From here the coal is elevated in a two-ton skip bucket to a hopper located above the level of the coal bunkers and, after passing through a crusher, falls upon a distributing belt and is distributed to the coal bunkers. These discharge through chutes to the stokers.

The coal which drops through the chain-grate stokers is drawn from the ashpits with long-handled shovels and is dumped into the ash buckets. These are hoisted and emptied into a car which is run out over the coal-receiving pit. This method allows the coal droppings to become thoroughly mixed with all the coal burned, and prevents clinkers which would be formed if the droppings were shoveled directly into the stoker hopper of each boiler. The heat units in these droppings are estimated to average about 7000 B.t.u. per pound.

The coal is purchased on a B.t.u. basis, the analyses of the samples for each month being averaged and the price determined thereby. Both premiums and penalties are provided and these are based not only upon the heat value shown by the average analysis, but also upon the percentage of ash and sulphur.

The ashes are handled by telpher-operated buckets and discharge into hand cars by which they are removed from the boiler room.

In connection with the operation of the boiler room, it may be mentioned that the external surfaces of all the tubes are cleaned daily, and it is the duty of the men who blow the surfaces of these tubes to also stop all air leaks in the settings and furnaces. An air-driven tube cleaner is now used, and this has been found to result in longer life of the arches of the dutch ovens, for when the tubes were cleaned with a water-driven cleaner a large amount of the leakage dripped on top of the arches, and consequently shortened their lives. It is the custom to clean each of the boilers in service every 35 days.

HEATER AND PUMPS

Feed water is furnished by two separate 6-in. city mains leading to an open surge tank located on the roof of the boiler room. From here it flows by gravity to two 10,000-hp. Cochrane feed-water heaters, thence to the feed pumps. The discharge from the water-backs at the bridge-walls, which is under the city pressure of 90 lb. per square inch, is also connected into this system. Furthermore, there is a connection between the city mains and the boiler-feed pumps for emergency use, and additional protection against shutdown is afforded by a 6-in. two-stage centrifugal pump which can supply the main feed-pump suction with water from the station reservoir in case of trouble with the city mains.

ENGINE AND GENERATORS

The generating equipment consists of six Corliss engine-driven units and three turbo-alternators, all receiving steam at 175 lb. pressure, and 100 deg. superheat. The engines were originally designed double, but have now been made cross compound.

The railway system is supplied by one 1600-kw. and two 850-kw. 600-volt units, and the Edison three-wire system by one 400-kw., 125-250-volt generator, which also serves as an auxiliary for the exciter system. The 2300-volt system is composed of two 1500-kw. engine-driven units, two 3000-kw. Curtis turbines, and one 6250-kw. Allis-Chalmers horizontal turbine. These exhaust into a LeBlanc condenser.

Three 1000-kw. Westinghouse rotary converters also form part of the railway system in parallel with the railway generators, and the Edison three-wire system includes three 750-kw. and two 500-kw., 125-250-volt rotary converters. The connections of two of the 750-kw. rotary converters are so arranged that they can

be run in series and paralleled on the railway system for emergency operation.

Excitation is furnished by motor-generator sets with an engine-driven exciter in reserve.

The arc-lighting system is supplied by six 100-light, seven 50-light and one 35-light constant-current oil-cooled transformers which furnish 7½-ampere series arc lamps with current from the 2300-volt system.

The 13,200-volt transmission system which furnishes power to the towns of Bessemer, East Lake, Ensley, Brighton, etc., is supplied from the 2300-volt system through three 750-kw. step-up transformers.

Cooling Towers

The cooling towers which have been installed to handle the condensing water are of the Worthington design, 30 ft. in diameter and 80 ft. high. They are built over the suction reservoir and are equipped for forced or natural draft, or a combination of both, and are connected to the condenser by 36-in. cast-iron mains. Motor-driven fans are employed.

Exhaust Steam Heating

The station is located about 1500 ft. from the business center of the city and in all there are about 11,500 ft. of heating mains ranging in size from 4 to 16 in. In the construction of this system of underground piping, thorough provision has been made for insulation, expansion, anchorage and durability. The wrought-iron pipe is first wrapped with asbestos paper, which is held in place by copper wire. Between the pipe and the wooden insulating casing there is a 1½-in. air space, the pipe being centered and supported on roller guides which permit movement due to expansion and contraction.

The chief insulation is secured by a wooden casing 5 in. in thickness. It is made from kiln-dried tongue-and-grooved white pine staves tightly bound together with a galvanized-iron wire, which is bound under a pressure sufficient to embed it into the wood. The casing is then covered with a coating of asphaltum and sawdust and the inside is lined with bright tin plate.

Great care was exercised when the mains were installed to protect them from seepage and provide proper drainage. For this purpose 3-ply tar paper was laid on top of the casing to a point below its center line and porous tile is placed below the mains; these being connected to the sewers at convenient points.

A device known as a variator is used for taking care of the expansion and contraction of the mains. This consists of a form securely anchored in a brick box, which holds the outer edge of a large corrugated copper disk, the inner edge of which is connected to the free end of the pipe. The expansion devices are placed about every 100 ft. apart,

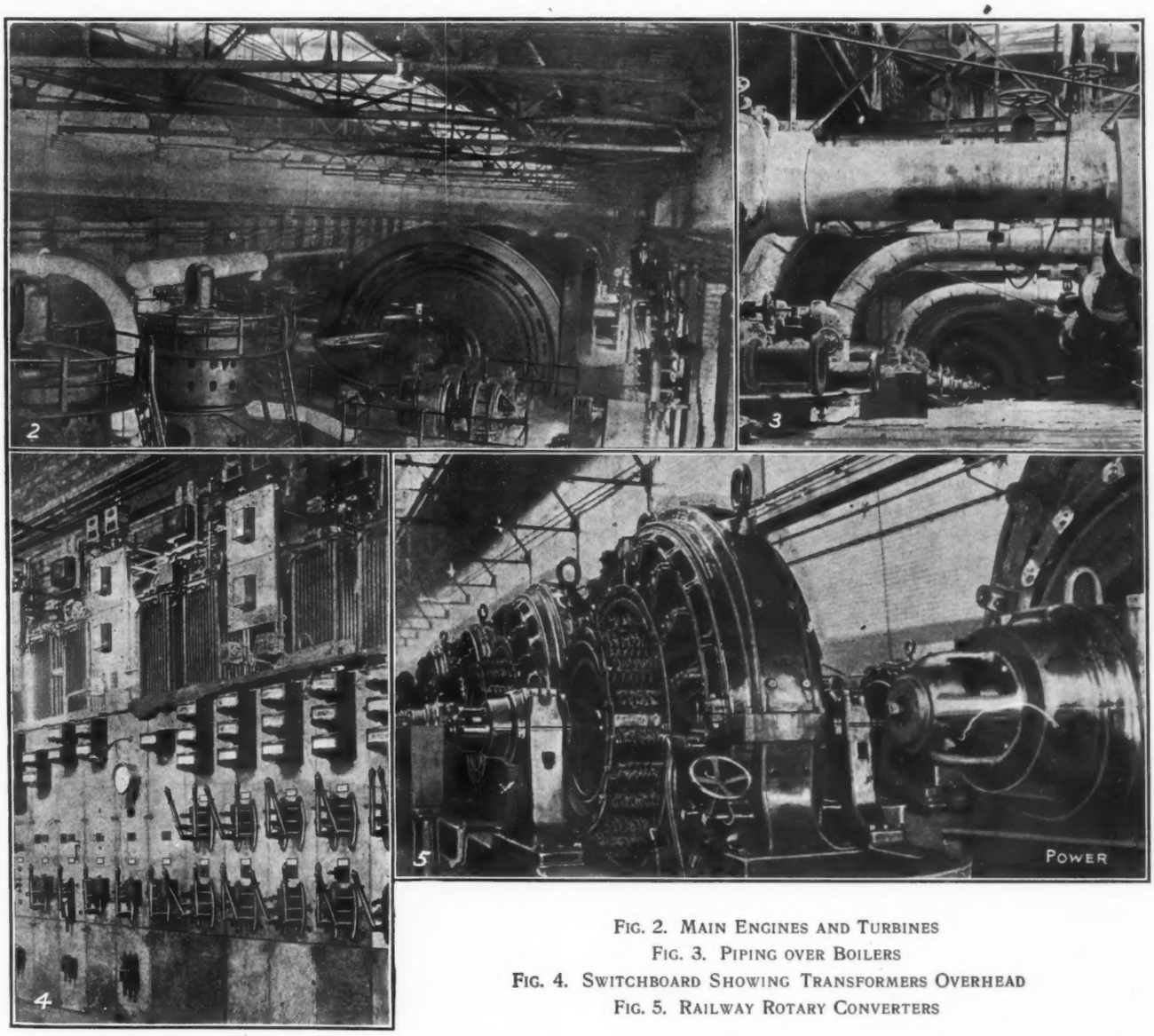


Fig. 2. Main Engines and Turbines
Fig. 3. Piping over Boilers
Fig. 4. Switchboard Showing Transformers Overhead
Fig. 5. Railway Rotary Converters

with anchors midway between. All the brick boxes inclosing the variators and anchors are filled with pine shavings to prevent radiation.

Consumers' service pipes branch from the top of the main line, thus insuring the delivery of dry steam to the consumer. Four-inch wooden casings are used for insulating the service pipes. Gate valves are placed in manholes at street intersections, so that small sections of the system may be shut off to make connections or repairs.

All the pipes are carefully graded to low points on the system where automatic steam traps are placed in manholes for the removal of condensation.

The consumers comprise practically all the small and large office buildings, business blocks, hotels, and public buildings, and all are served on a meter basis.

Explosion of Water Tube Boiler

By A. L. Howard

The accompanying photographs show the destruction following the explosion of a water-tube boiler at the mill of the Bond Lumber Co., of Bond, Miss., on Feb. 19. Besides the damage to property, estimated at about $60,000, three men were killed and two others seriously injured.

The boiler which exploded was of the Woods type and was rated at about 200 hp. It was built in 1894 for the Eddy Co., of Saginaw, Mich., by which firm it was used until 1902. It was out of service for the next three years, remaining in a damp and often flooded boiler room, and was then sold to the J. E. North Lumber Co. (now the Bond Lumber Co.) who operated it up to the time of the explosion.

On Sunday, Feb. 18, the day before the explosion, the boiler was washed out and was fired up about 11 p.m.; the explosion occurred at 2:05 a.m., Monday morning. Several versions are given as to the contributing cause of the explosion, one of the attendants stating that the water was low and upon turning on the injector the explosion took place. It is probable, however, that definite information will soon be available as to the actual cause, as a thorough investigation is now being made by the authorities and the insurance company which held insurance on the boiler.

The boiler plant consisted of five return-tubular and four water-tube boilers. The front tube header of the exploded boiler was thrown about 1500 ft. from the plant and part of the steam drum was hurled onto the log deck of the sawmill. The rear tube header was blown through the sawmill and landed under the filing room.

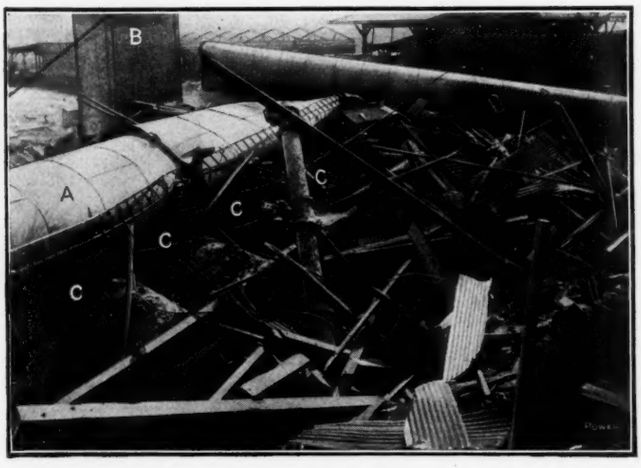


FIG. 1. SHOWING STACK A OF EXPLODED BOILER LYING ACROSS THE RETURN-TUBULAR BOILERS C; B IS THE BASE OF THE STACK FOR THE LATTER BOILERS

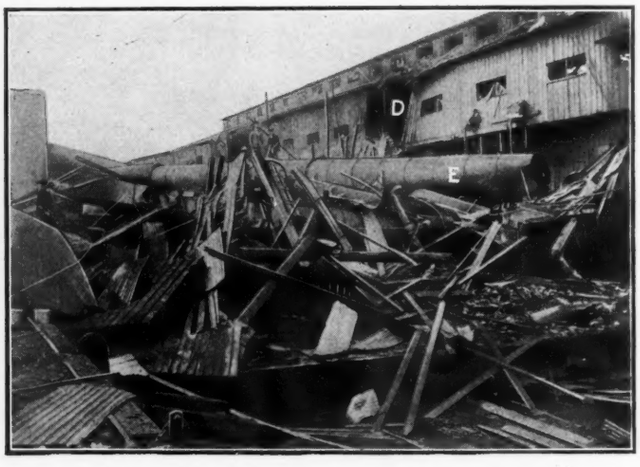


FIG. 2. DEMOLISHED BOILER ROOM; D SHOWS WHERE STEAM DRUM WENT THROUGH SAWMILL; AND E THE STACK OF THE EXPLODED BOILER

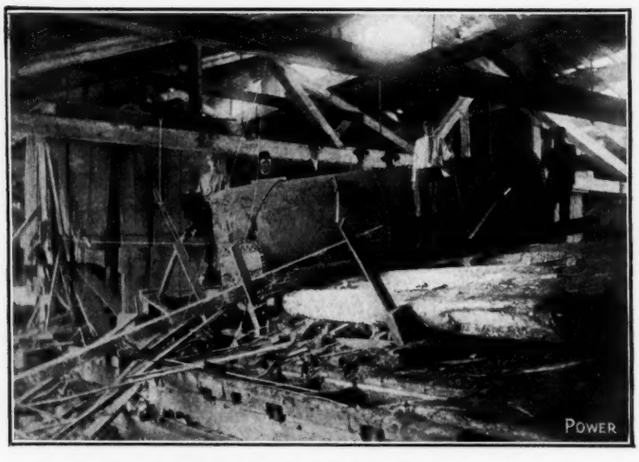


FIG. 3. STEAM DRUM OF EXPLODED BOILER ON LOG DECK OF SAWMILL

FIG. 4. END VIEW OF BOILER ROOM

William States Lee

Few men have contributed as much or as efficient personal endeavor to the industrial development of any section of the South as William States Lee, chief engineer of the Southern Power Co. Mr. Lee was born in 1872 in Lancaster, S. C., and after the usual primary education he received technical education at the South Carolina Military Academy, from which he was graduated in 1894. After graduation he taught for a time, but soon took up engineering work and rose rapidly from transit man to resident engineer of the Pickens Railway Co.; subsequently he became resident engineer of the Anderson Water, Light & Power Co. When with the latter company he had charge of the construction of the Portman Shoals hydro-electric plant on the Seneca River, in which was installed the first 10,000-volt generator put in service in America. After putting this plant into operation, Mr. Lee spent about a year on construction work in connection with the United States Government coast-defense plans for Charleston Harbor.

In October, 1898, he became resident engineer of the Columbus Power Co., which company had just then let the contract for a dam on the Chattahoochee River at Columbus, Ga. This dam was completed in the autumn of 1900 and in December of that year part of it was carried away by a flood. The reconstruction of the dam, together with the building of transmission lines, substations, etc., was put under Mr. Lee's direct supervision and he was made chief engineer. He modified the design and raised the height of the dam, completing it in the spring of 1902. It is to be noted that this river is remarkable for its quickly rising floods, which often exceed fifty times the normal flow. This was the first large dam built in the South, and the experience gained in fighting a river with such quickly rising floods may account for much of Mr. Lee's success in later developments where similar conditions were encountered. During his connection with this company Mr. Lee also became familiar with cotton-mill construction, an experience which has served him well in his present connection.

After reconstructing the dam at Columbus and completing the electrical installation, he was appointed chief engineer of the Catawba Power Co. This company was building a dam at the India Hook shoals of the Catawba River, near Rock Hill, S. C., and three contractors had failed in the undertaking on account of the great difficulty involved in dealing with the floods which rise in this river. The dam was completed in the spring of 1904, together with transmission lines to Rock Hill and Charlotte (N. C.). The capacity of this plant was 10,000 hp., and the rapid sale of the entire output led to the formation by the same interests of a much larger company under the name of the Southern Power Co., which took over the Catawba Power Co. and purchased large water-power rights on the Catawba and Broad Rivers in the summer of 1905. Mr. Lee was made chief engineer and in addition was given an executive office, second vice-president, with headquarters at Charlotte.

Before the organization of this larger company, hydro-electric development in the South had been mostly local in scope, having for an object the supply of power to a few cotton mills in the immediate neighborhood of the power plant or at the end of a comparatively short transmission line. It remained for Mr. Lee to produce a network system extending over hundreds of square miles and rivaling in the amount of power transmitted

WILLIAM STATES LEE

any hydro-electric system in the world. Since the summer of 1905 there have been built under his direction two 24,000-kw. and one 18,000-kw. hydro-electric developments; 500 miles of 50,000-volt circuits; 800 miles of 100,000-volt circuits and about 70 substations supplying power and lighting to more than 150 cotton mills and 45 towns. The pioneer work involved in this project included the erection of a 100,000-volt transmission and distribution system reaching 200 miles in one direction and over 100 miles in another direction, tied in to a 50,000-volt distributing system and operated with the same degree of safety as a low-tension system.

Not content with supplying power to the mills of the Piedmont region, Mr. Lee has for several years been studying the railroad problem, and has so far interested the financiers of the Southern Power Co. that for the last year he has been actively engaged in the construction of a high-speed freight and passenger electric railway, 150 miles long, which for the present will connect with the Seaboard Ry. at Charlotte and Greenwood. He is also making a study of the problem of extracting nitrogen from the atmosphere by means of the electric arc. A plant for this work has been in course of contruction at Great Falls for more than a year, and it will probably be in operation by the time this sketch appears in print.

Mr. Lee possesses to a remarkable degree the unusual combination of keen business sense and engineering ability, which enables him not only to design, construct and operate his plants, but also to develop them to their fullest commercial efficiency and put them on a firm business basis. His ability to analyze quickly the most difficult problems and his knack of inspiring confidence in all with whom he comes in contact are striking characteristics.

He has always taken an active part in industrial and other affairs which pertain to the welfare of this country. He has, for instance, been warmly interested in the preservation of the natural resources of the country, especially of the forests, and has appeared before the congressional committee on conservation of forests at various times.

Although Mr. Lee has always been and is still a very busy man, he always has time to discuss matters with his men, or with his customers, or to help along any project tending to the advancement of the interests of the community in which he lives.

Mr. Lee does not impress the casual observer as being aggressive, but his excellent judgment, quiet but indefatigable perseverance and great personal magnetism produce results that demonstrative aggressiveness would not. His successful work in connection with the Southern Power Co. and its allied interests has attracted the attention of the electrical and commercial world by reason of the comprehensive range of its operations, and has caused financial powers to show more confidence than ever in the future of the South.

Mr. Lee is a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers and the American Society of Mechanical Engineers; president of the Engineering Association of the South, and of the Greater Charlotte Club and the Commercial Club of Charlotte.

Electrical Department

Conducted to be of service to the men in charge of electrical equipment in the power house

An East Tennessee Hydro-electric Development

By F. R. Weller*

There has recently been completed and put in operation in Carter County, Tenn., a hydro-electric power plant which has the distinction of being the first important plant of this character completed in the state. The power house is located on the Watauga River, eight miles above Elizabethton. This river rises in the mountains of western North Carolina, and is fed by many large springs, which tends to yield an uniform minimum flow. The total drainage area above the site of the dam is 406 square miles.

The dam and power house are constructed at a point where the river breaks through the last of the mountain gorges previous to flowing through a wide cultivated valley to its junction with the Holston River. At this point the rocky cliffs are very precipitous and afford excellent anchorages for the dam.

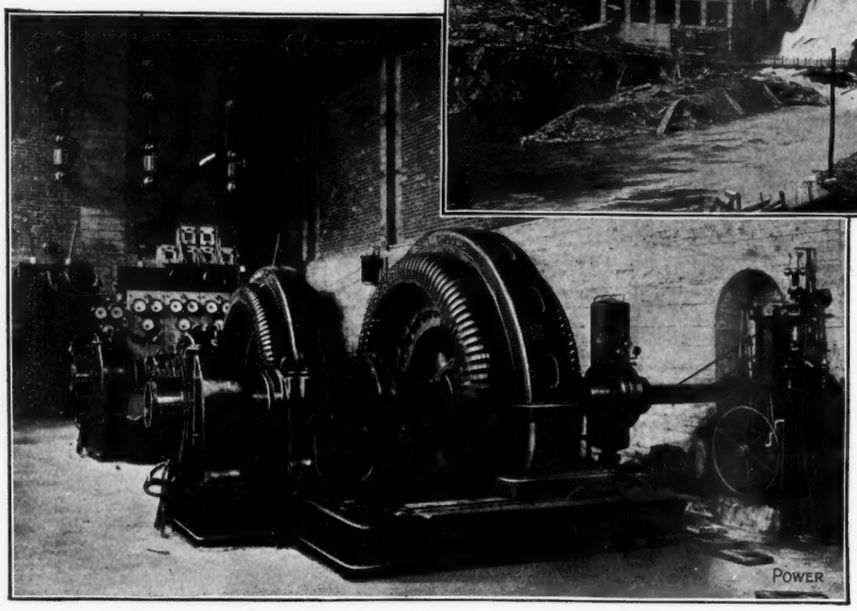


Fig. 1. A Corner of the Watauga Generator Room

The dam and abutments are 270 ft. long and the spillway crest of the dam is 55 ft. above low water. The thickness of the dam at the base is 58 ft. 6 in. It is of the gravity type built of cyclopean concrete in proportions of 1 to 2½ to 5 on the face and 1 to 3 to 6 in the core of the dam. The upstream face of the dam is vertical and the downstream face has an ogee profile.

The north end of the dam is built up in an abutment wall in which are set the head racks and gates for controlling the water to the turbines. The power house is on the downstream side of this part of the dam, as shown in Fig. 2. Three 10-ft. steel penstocks have been built thus far in the abutment wall. Each penstock carries the water to a pair of 33-in. Morgan Smith wheels mounted on a horizontal shaft. At the present time only two units have been installed, but full provision has been made for another unit of the same size later on.

The wheels are inclosed in steel cases and are located between the power-house wall and the face of the abutment wall. Steel draft tubes carry the discharge water into the tailrace under the power house. Considerable expense was involved in the construction of this tailrace, which required the excavation of over 15,000 yd. of solid rock in order to keep the tail water flowing from the wheels separated from the water flowing over the crest of the dam for a sufficient distance below the dam to maintain a uniform head during normal periods of flow.

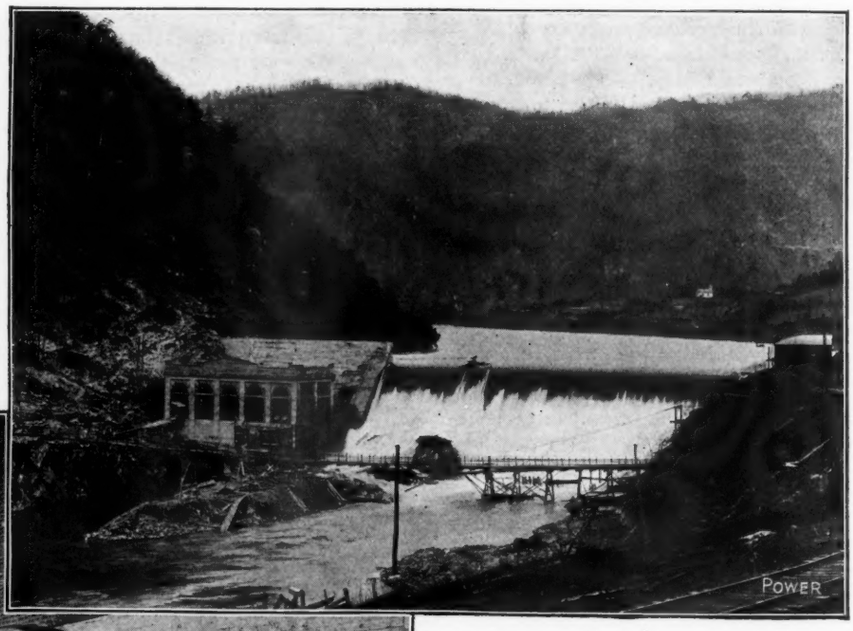


Fig. 2. Watauga Power House

Power House and Equipment

The power-house superstructure is supported by means of 4-ft. piers carrying full centered concrete arches with 14-ft. spans and crowns 3 ft. thick. The superstructure is built of reinforced concrete with brick spandrel walls. The windows, frame and sashes are of steel —in fact, the whole power house is absolutely fireproof with the exception of the wooden roof sheathing.

The turbine gates are controlled by hydraulic governors, each belted to the turbine shaft, as shown in Fig. 1. Each turbine shaft extends through the wall of the power house and is direct-connected to the shaft of a 1000-kw. Westinghouse alternator delivering three-phase currents at 60 cycles. Each generator is separately excited at 125 volts

*Consulting engineer in charge of the design and construction of the plant.

by means of a direct-connected 50-kw. shunt-wound exciter. The switchboard controlling the output is very compact; it stands in one corner of the building, as shown in Fig. 1.

The cables are laid in conduits in the floor and are insulated with varnished cambric and lead-encased. In the north end of the building, back of the switchboard, are installed three single-phase oil-insulated air-cooled transformers, of 800 kilovolt-amperes each, which raise the voltage from 2200 to 44,000 volts for the transmission line. In the station are provided the necessary high-tension oil-break switches, disconnecting switches and choke coils and immediately outside of the power house are installed 44,000-volt electrolytic lightning arresters. All of the auxiliary electrical equipment is of Westinghouse make.

Transmission Line

The transmission line extends from the power house to Bristol, Tenn., a distance of 20 miles, and Elizabethton, about 7 miles distant. At a point about five miles from the power house a line branches off and runs to Elizabethton. At this junction is installed a switching tower with the necessary disconnecting switches for cutting out either line from the main trunk line.

The transmission line is of No. 3 stranded aluminum, with 175-ft. spans most of the way. On spans exceeding 200 ft. a steel-core wire is used in conjunction with the aluminum wire in order to relieve the tensile stress on the conductors. The line is mounted on 50,000-volt Thomas insulators with Lee wrought-iron pins. The wires are strung 5 ft. apart, center to center, with delta spacing. They are supported on second growth chestnut poles, except at the entrance into Elizabethton, where 55-ft. steel towers are used.

At Bristol there is a substation containing three step-down transformers, each of 800 kilovolt-amperes capacity, reducing the voltage from 44,000 to 2200 for delivery to the Bristol Gas & Electric Co.; all electric power transmitted to Bristol is distributed by this company for the usual lighting and power purposes. At Elizabethton, the power is delivered through step-down transformers to the Watauga Power Co.'s own central station. The lines at the entrance to each substation are equipped with electrolytic lightning arresters.

Full consideration was given to the relative merits of copper and aluminum for transmission-line purposes. In this section the rainfall is very heavy and severe sleet storms occur during the winter months. It had been found by previous experience that there is less trouble from the formation of sleet on aluminum than on copper conductors, and this has been confirmed in the operation of the plant during the past winter months, when practically no difficulties developed from this cause. Aluminum conductors being 50 per cent. lighter than copper of the same conductivity, the pole spacing can be increased and the cost of the poles and setting them thereby reduced.

The construction of the dam and power house was carried out under great difficulties, due to floods, freshets and severe weather, by R. L. Weide, resident engineer during this period, and Mr. Weide is entitled to much credit for the expedition and thoroughness with which this work, as well as the erection of the transmission lines through wild, rough country, was accomplished.

Armature and Coil Testing Outfits

The advantage of using alternating current for testing purposes is well exemplified by the facility with which armatures and individual coils may be tested for breaks and short-circuits by means of the testing sets illustrated herewith. One of these, Fig. 1, is for testing individual coils and the other is for testing a complete armature winding.

The apparatus shown in Fig. 1 consists of an E-shaped electromagnet with a detachable "keeper." An exciting coil surrounds the middle leg of the E. On the yoke of the E, between the middle leg and each outside leg, are wound two small coils so connected that the potentials induced in them by the flux set up by the exciting coil oppose each other and are exactly equal under normal conditions; consequently, no current flows under such conditions. The magnet or armature coil to be tested is placed over one of the outer legs of the E and the armature bar is omitted. If the tested coil is without fault, it has no effect on the flux distribution. If, however, a leak or short-circuit exists, a current is induced in the short-circuited part of the tested coil which so alters the distribution of the flux that more passes through one of the detecting coils than through the other, inducing higher voltage in one than in the other and thereby causing a current to flow through them. This current is indicated by means of a central-zero millivoltmeter or by means of a special telephone receiver.

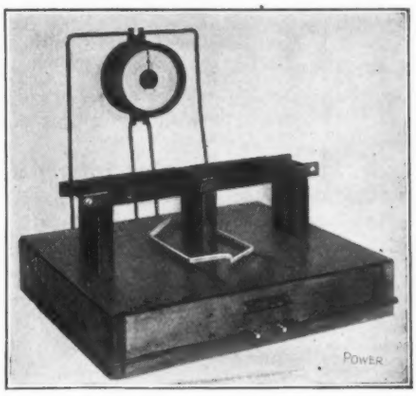


Fig. 1. Coil-testing Outfit

To locate a short-circuit in a coil by burning it out, the coil is placed on the middle leg of the E, the detachable armature bar put in place as shown in Fig. 1, and the exciting coil connected to an appropriate source of current for a short time.

The device for testing complete armatures, illustrated in Fig. 2, consists of a bipolar electromagnet with a laminated iron core in which an alternating magnetic flux is set up by connecting the terminals of the exciting coil to a source of alternating current. When the pole faces of this magnet, which are shaped to fit the curve of an armature core, are applied to either a direct-current or an alternating-current armature carrying a winding connected to a commutator, an alternating flux passes through the armature core and if the armature winding is in normal condition, the electromotive forces generated counterbalance each other and no current passes through the winding.

Passing a piece of metal around the commutator short-circuits in succession each of the coils, and if there is no fault in the winding a decided spark occurs as the metal leaves each bar. Absence of spark between two bars indicates either a short-circuit or an open-circuit, and it may indicate a reversed coil in the winding. Either a short-circuit or reversed coil will cause a local current in the coil which will generate a flux in the teeth between which the coil lies; this local flux can be detected by running

Fig. 2. Armature-testing Magnet

over the surface of the armature a piece of sheet iron held lightly, bridging from one tooth to the next successively. A local flux caused by a short-circuit or reversed connection will attract the piece of iron when it bridges across the slot containing the defective coil. If no such local flux is detected, the fault disclosed by the sparking test is due to an open circuit.

The magnet is mounted either on a stand provided with wheels, as shown here, or on a stationary stand. Two sizes are made, one for armatures under 12 in. in diameter and one for armatures 12 in. or more in diameter.

These testing sets were originally built by the Westinghouse Electric & Manufacturing Co. for use in its own shops only, but they proved so satisfactory that the company recently decided to build them for general sale.

Promiscuous Paralleling

By George W. Malcolm

The Georgia Railway & Electric Co., of Atlanta, operates both water-power and steam generating plants, and in the steam station there is also a 3000-hp. Snow gas engine which is operated on illuminating gas only while the peak load is on. During the small hours of the night and part of the day, water power alone is used, except on cloudy days when the lighting load is heavier than usual. When the load gets beyond the ability of the hydraulic station, a 1000-kw. Corliss-engine unit is put in parallel with the high-tension line at the Davis Street station in Atlanta. Later in the afternoon a 2000-kw. steam-turbine unit is put on the line, and about 5:30 or 6 o'clock, according to the season, the gas-engine unit is added.

These four different types of prime mover drive three-phase 60-cycle alternating-current generators in parallel (through step-up and stepdown transformers between the water plant and the city station) with the utmost harmony. There is no surging, and cross-currents are practically eliminated by giving a little attention to the adjustment of the field excitation occasionally. The writer visited the Davis Street station one afternoon recently and witnessed the addition to the system first of the turbine unit and later of the gas-engine unit, and was greatly impressed by both the smoothness with which these units "went in" and the placidity with which they divided up the load after going on the line.

The current from the water-power plants comes to the city limits at 50,000 volts and is there stepped down by transformers to 11,000 volts, at which pressure it is transmitted to the Davis Street station. This station is the distribution center of the system.

Ilgner Drive for Rolling Mills

In the course of a paper relating to electric driving of rolling mills, read at a recent meeting of the (British) Institution of Electrical Engineers, C. Antony Ablett referred to the necessity for a mill motor, when used in conjunction with a flywheel, to fall in speed when the power demand is large, so as to enable the flywheel to give up some of its stored energy, which causes a diminution in the tonnage which the mill can roll. This reduction of tonnage is more marked where the mill is engine-driven than where it is motor-driven.

To overcome this difficulty, Mr. Ablett says that several steel works have adopted the Ilgner system for driving large three-high mills—that is, the same type of electrical plant is used which is generally employed for driving reversing rolling mills. In this system the flywheel is not attached to the mill but to a motor-generator set which supplies current to the mill motor. The mill motor runs at a constant speed whatever power it is required to give; consequently, there is no reduction in tonnage owing to reduction in speed in the mill. The motor-generator set, instead of the rolling mill motor, varies in speed so that the flywheel can give up its stored energy when the power demand is great and absorb energy when the demand is small in order to reduce to a reasonable value the variation in power taken from the supply system.

It is claimed that by using the Ilgner system the possible output from the mill can be increased beyond that which may be obtained if the mill motor were driven directly at constant speed. The capital cost of the electrical plant for this system of driving is higher than that of a plain motor and flywheel, but it enables a much larger output to be obtained and therefore cheapens the cost of production by reducing the capital charges per ton rolled.

Some of the salient points brought out in the paper are the following:

The stored energy of the flywheel varies as the square of the speed at which it is running, so that if a flywheel were used in conjunction with a three-phase induction motor running at light load it would give up only 4 per cent. of its stored energy as the power increased from light load to full load on the motor.

The value of the time constant for a motor and flywheel does not usually exceed about 33 seconds. The value of the time constant to be selected naturally depends on the type of mill. In a sheet mill where the duration of the passes is very short the time constant need not be so big as in the case of a bar mill where the finishing passes may take considerable time. The greatest time constants are found in the case of motor and flywheel for the motor-generator set of an Ilgner system applied to a reversing rolling mill.

The difficulty with the intermittent-slip regulator is that it is comparatively slow in coming into operation on account of the inertia of the various moving parts. Such slip regulators often take from 1 to 2 seconds to come into operation, and as the increase in power demanded from a rolling-mill motor when the rolls bite the bar is practically instantaneous, the power will rise to its maximum value before the intermittent-slip regulator can come into operation. Therefore, instead of reducing the power to the mean value, as would appear to be the action of the automatic-slip regulator from academic considerations, it actually is the means of producing very bad peaks indeed.

Care should be taken that the hourly output of the mill is kept as steady as possible, for if the mill were worked rapidly for an hour or two and then there was a long wait for billets to heat in the furnace, or for some other cause, the rapid rolling would be found to affect the cost of power very adversely.

The ideal drive is a constant-speed motor for the roughing mill and a separate variable-speed motor for the finishing mill; when this is done the roughing and finishing mills are usually worked in tandem. Where the supply available is direct current, this arrangement presents no difficulty, but where three-phase current must be used, the means of providing a variable-speed drive for the finishing mill needs careful consideration. The simplest arrangement would be to provide an ordinary three-phase motor and to reduce its speed when required by inserting resistance in the rotor circuit.

Generally speaking, where there is a choice between direct and three-phase currents for driving a mill for which variable speed is desirable, and there is little or no difference in the cost of electricity, the adoption of direct current will be found the most economical.

In many mills the power consumed by the friction of the mill itself is about ⅓ or ⅙ of the normal rated output of the motor which is installed to drive the mill, so that nearly 50 per cent. of the electricity used per ton rolled is wasted in friction.

In certain mills, particularly in brass and copper sheet mills, long trains of gearing are usually put in for transmitting the power of the motor to the rolls and are so arranged that the power for the more distant mills is transmitted through perhaps ten different pairs of gearwheels; a more wasteful way of applying power could hardly be imagined.

The electrical drive often allows cheap power to be used when it could not be transmitted or applied in any other way.

Gas Power Department

Worth-while gas-engine and producer information treated in a way that can be of practical use

A Dependable Small Producer Plant

By R. C. Turner

At the Fulton County almshouse, 10 miles out from Atlanta and isolated from all railroads and traction facilities, is to be found one of the most interesting very small power plants in the South. When the question of furnishing the buildings with water and electricity was considered by the county commissioners, three different proposals were entertained: first, one for a complete steam plant, with high-speed engines; second, one to build a transmission line five miles in length and take current from the local hydro-electric power company, installing at the almshouse three-phase transformers to step the current down to 220 volts for lights and power; third, one for a complete local gas power plant.

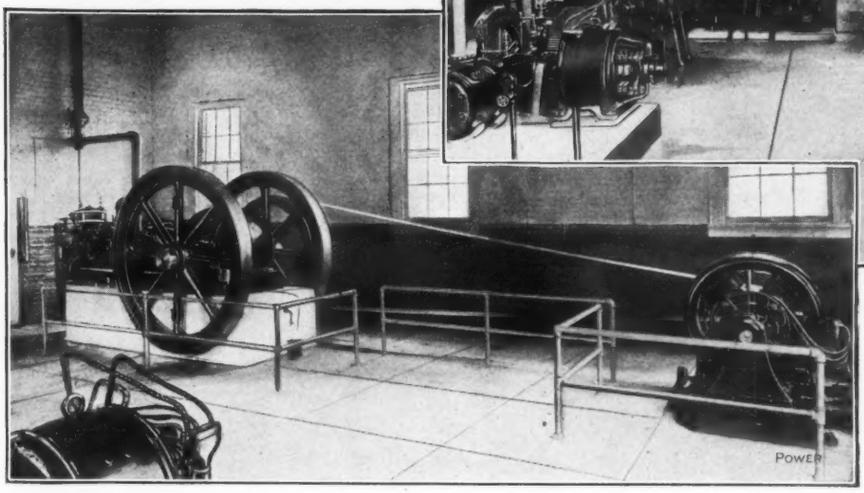


Fig. 1. The Main Generating Unit

On account of the long haul of coal from the railroad, six miles away, over a rough and hilly country, the cost of operating a steam plant was considered too high, and in consideration of the uncertainty of continuous service and the high cost of the pole line and transformers, the straight electrical plan was discarded. The proposal to install a gas engine and bituminous gas producer was accepted.

The contractors were asked to install the simplest plant possible, keeping in mind the location of the plant and the service to be rendered. Following out this idea, it was decided to install a bituminous gas-producer outfit, a simple single-acting gas engine belted to a direct-current generator, and an air compressor driven by a small gasoline engine for providing air to blow up the producer and start the engine and by a motor supplied with current from the dynamo belted to the main engine, after that is running. These auxiliaries are shown in Fig. 3.

The gas producer is the special feature of the equipment. It is an Akerlund down-draft apparatus, the draft for which is maintained by a motor-driven exhaust fan. From the generator the gas passes through a cooler and a coke-filled wet scrubber; from there, through the exhauster to an expansion tank and thence to the engine at a pressure of about 4 in. of water. A detailed consideration of the producer system is worth while. Fig. 6 gives a sectional view of the complete system. The generator is fitted with a water pan *H* in the top from which water and steam pass to the main vaporizer *V* around the combustion zone. The water level in the pan *H* is maintained by an overflow *E* which delivers to the main vaporizer *V*; a pipe, not shown, connects the *top* of the pan *H* also with the vaporizer and transfers any vapor that may be formed in the pan. An overflow standpipe *F* serves to seal the vaporizer and also to limit the upper water level therein.

Water is supplied to the pan *H* through the small pipe shown at the right-hand side of the generator top and the supply is regulated by hand; the rate of delivery from the pan to the vaporizer is observed at the overflow outlet *E*.

Air for the generator is taken in at *A* and passes through the vaporizer *V* to the uptake pipe *B*, which delivers the air, with steam, to the top of the generator chamber. The gas-making process is the same as in any down-draft single-zone generator. From the generator, the gas passes through the outlet *D* to the cooler, which consists of two vertical pipes connected at the top ends by a water-sealed baffle chamber or trap *G* and containing about half a dozen water sprays in each leg. From the second leg of the cooler, the gas passes through the wet scrubber, exhauster *J*, dry purifier and delivery pipe *K* to the engine.

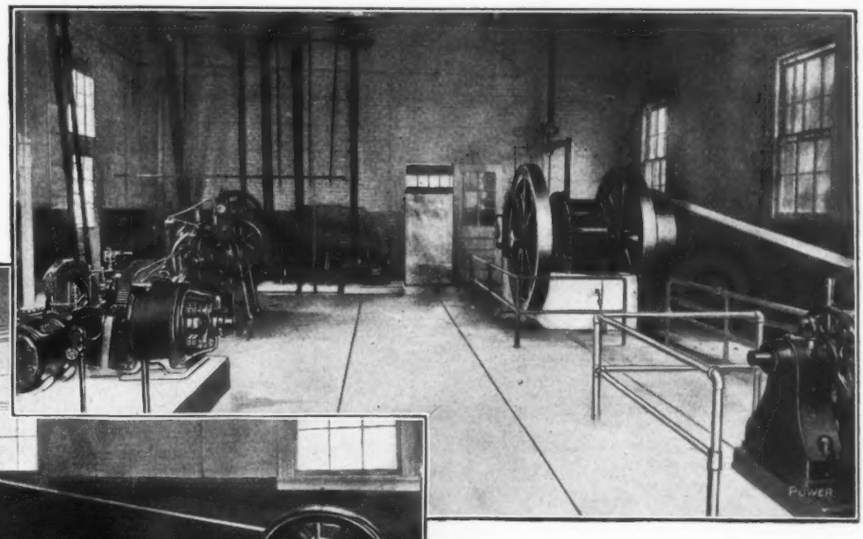


Fig. 2. Motor-driven Pumps and Main Engine

Immediately above the tee connecting the dry purifier with the delivery pipe *K* is an automatic bypass valve *L* which is set to open when the pressure exceeds the normal, thereby allowing some of the gas to pass through the pipes *M* and *N* back to the scrubber, the three-way valve at the junction of the pipes *M*

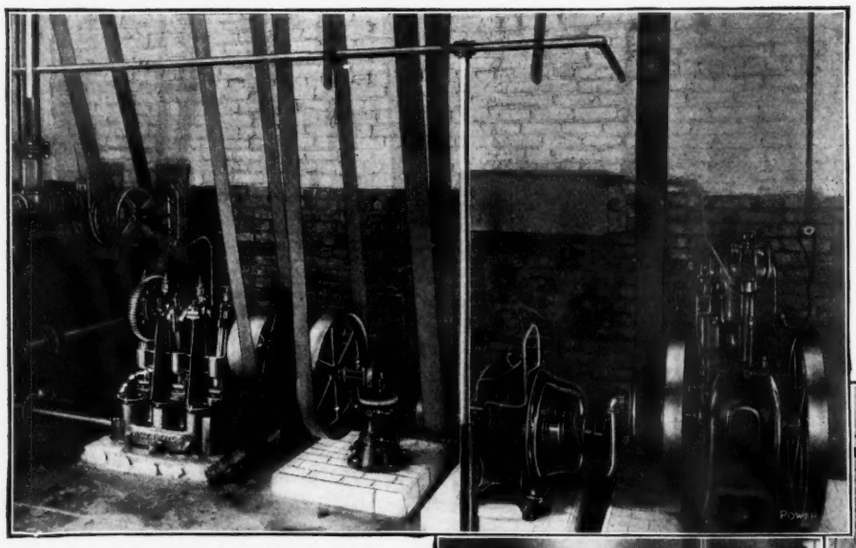
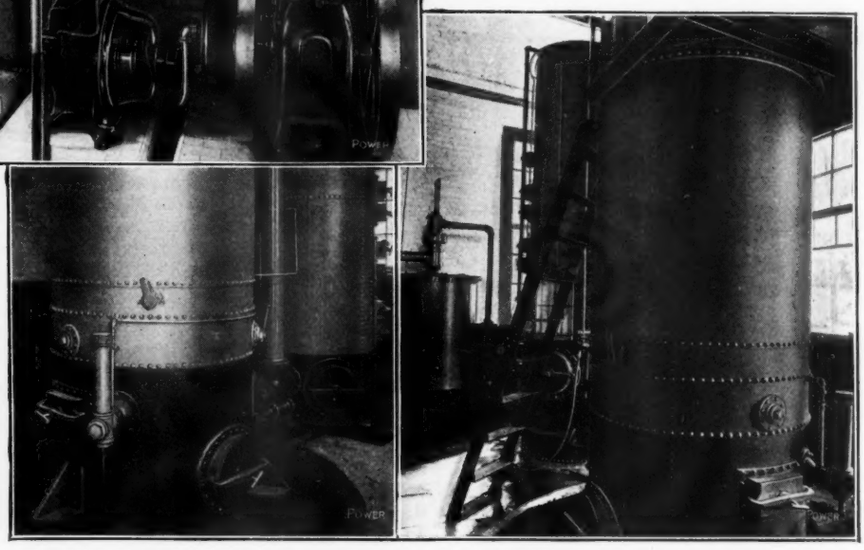


FIG. 3. POWER-PLANT AUXILIARIES

and *N* being normally set to connect these pipes and close off the pipe *U* leading into the generator delivery outlet.

For blowing up the fire in the generator, at starting or after a standby period, the three-way valve just referred to is set to connect the pipes *M* and *U* and block off the pipe *N;* the water-sealed trap *G* is closed; the plug in the tee at the upper end of the large pipe connecting the scrubber with the exhauster *J* is removed, the purge pipe *P* is opened to the atmosphere and the valve at the upper end of the pipe *B* is closed to prevent blowing into the vaporizer. The exhauster takes air from the atmosphere through the now open end of the tee above it and forces the air through the dry purifier, the bypass valve *L,* which yields readily to the pressure developed, the pipes *M* and *U,* the fuel bed in the generator and out at the purge pipe *P.* During this blowing-up process, the draft through the generator is upward, of course. As soon as the fire is established, the plug is replaced in the scrubber-connection tee, the three-way valve at the junction of the pipes *M* and *N* is changed over, the cock in the waste pipe *R* is opened, the trap *G* is drained, the valve in the pipe *B* is opened and the purge pipe *P* closed off. When gas of the right quality is obtained at a test burner sup-



FIGS. 4 AND 5. PRODUCER CLEANING FLOOR

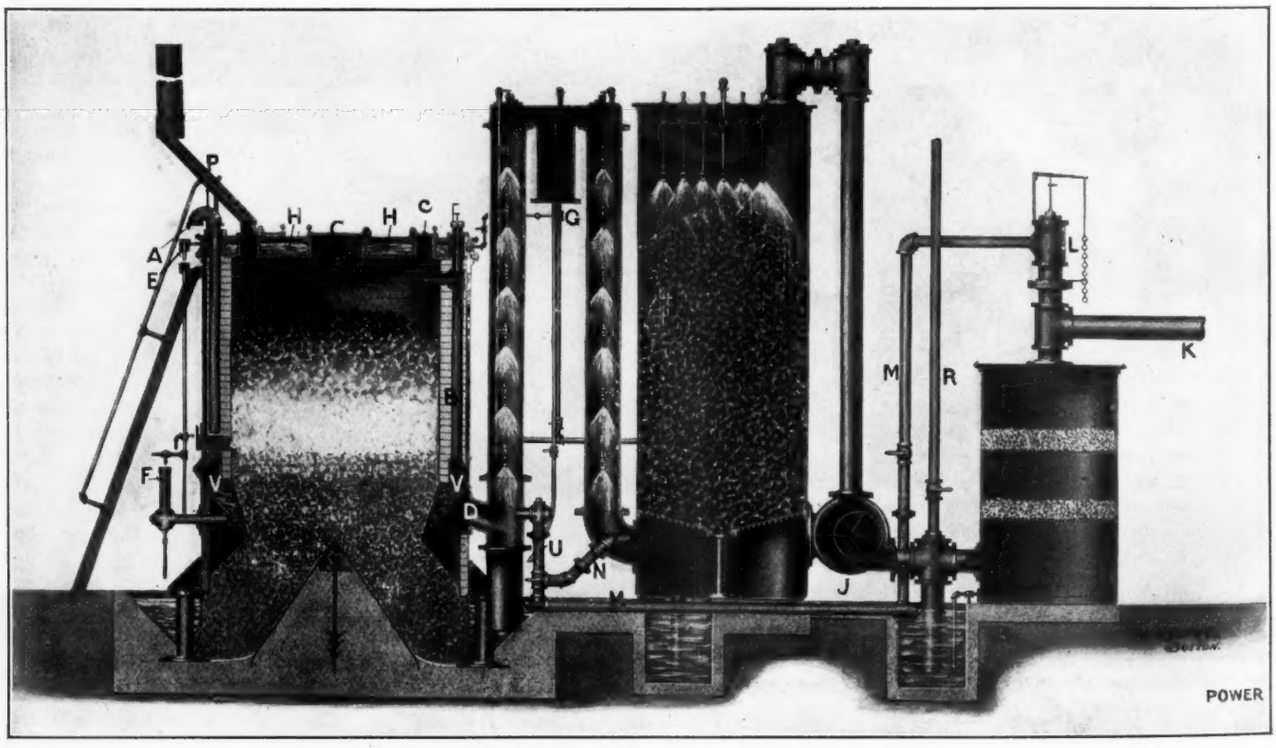


FIG. 6. SECTIONAL ELEVATION OF COMPLETE AKERLUND PRODUCER EQUIPMENT

plied from the waste pipe *R*, the cock is closed and the engine started, unless it happens that the producer is ready before the starting time of the engine; in that event, the pipe *R* is kept open to the atmosphere until starting time, in order to maintain the draft through the fuel bed and keep it alive.

The main engine is a single-acting Otto, working on the four-stroke cycle, and it drives a 50-kw. Allis-Chalmers direct-current dynamo. There are no special features in either machine.

For pumping the water required in the buildings and power house, an air compressor gear-driven by a 10-hp. motor is used. The compressor maintains an air pressure of 70 lb. per square inch in a receiver from which the air is piped down into a 300-ft. well and delivered to the usual deep-well lift. The water is delivered by the air lift into a 13,000-gal. reservoir from which it is pumped up to a general supply tank, 160 ft. above ground, by a 15-hp. motor-driven triple-plunger pump; the motor and pump are connected through rawhide gears. From this supply tank the water is piped to the various buildings about the grounds, through complete fire and domestic water systems.

In starting up the power plant, the small gasoline engine is started and connected to the auxiliary line shaft by a friction clutch. From this line shaft are belt-driven the producer fan, the circulating-water pump and a small air compressor for filling the tank with air for starting the main engine. As soon as the air in the tank reaches a pressure of 200 lb., the compressor is stopped and the gas engine is started with the air. After the engine "takes hold" and the dynamo voltage is brought up to normal, the small electric motor relieves the gasoline engine of the auxiliary load and the engine is shut down.

The plant is operated from 2 p.m. until 10 p.m. Immediately after starting up every afternoon the pumps supplying the water service are set to work and run continuously until the lighting load comes on, when they are shut down. By operating the plant in this manner the load on the generating equipment is practically the same at all hours of the run. The producer operates on common soft coal costing $1 per ton f.o.b. at the mine. The average coal consumption for the 8-hour run is 2.17 lb. per kilowatt-hour, including everything. For cooling the gas and the gas-engine cylinder, 15 gal. of water per kilowatt-hour are used. By using the circulating pump shown in Fig. 3, this consumption can be reduced to a much lower figure.

A feature of more than passing interest is that this plant is being successfully operated by an engineer who came directly from a steam plant and took charge without having any previous gas-engine experience.

Rock Filling for Concrete Foundations

By A. G. Campbell

It is the usual practice to build concrete foundations for engines of solid concrete; that is, from a uniform concrete of cement, sand and crushed stone or gravel. Recently the writer inspected a foundation that was under construction for a gas engine and electric generator set for which a method was being used that seemed to be new. Instead of making the foundation wholly of concrete, the erector was placing in it many very large boulders.

The appearance of a section of the

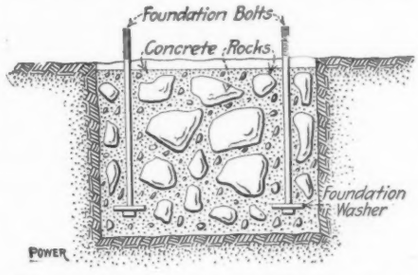


Fig. 1. Boulders in the Foundation

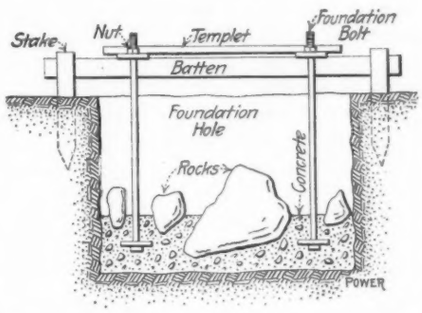


Fig. 2. Method of Building Foundation

resulting foundation is indicated roughly in Fig. 1. The rocks were plentiful in the vicinity and cost only the price of the labor required to get them to the foundation site. Each boulder was wholly surrounded by concrete so there appears to be no reason why the resulting foundation is not as good as if it were solid concrete. The cost of the foundation was considerably reduced through the use of the boulders.

In building, the method suggested in Fig. 2 was followed. The foundation bolt template was supported on battens nailed to stakes and the bolts were carried by the template. A layer of concrete, possibly 8 in. thick, was dumped into the hole and some was packed around each foundation-bolt washer to keep the bolts in place. Then several rocks were bedded in the concrete layer, enough being used to practically cover its entire surface. Sufficient space was allowed between adjacent rocks to permit the concrete to readily settle down between them.

After a layer of rocks was bedded in this way, enough additional concrete was tamped in to cover the rocks. Then another stratum of rock and concrete was placed, and so on until the foundation was complete.

An interesting feature of the foundation which the writer saw built was that no form was used in its construction. The earth in which the excavation was dug was solid enough to be self-sustaining; hence it was not necessary to use forms. The length, width and depth of the hole were made approximately equal to the corresponding dimensions desired in the foundation.

The Big Georgia Gas Engine

By Paul C. Percy

Probably everyone who has kept in touch with gas-power development in this country remembers that a few years ago a 3000-hp. twin tandem gas engine, with a 2000-kw. alternator, was installed in the main power house of the Georgia Railway & Electric Co., Atlanta, to carry the excess load during the peak period every day. It will also be remembered that for several months—about a year, according to report—this engine gave so much trouble that it was almost useless, if rumors were true; indeed, it was reported once or twice as being "down and out," and last December the writer was assured positively that the engine had been permanently shut down and the builders notified to remove the disappointing junk pile.

Thirty minutes prior to writing these lines, the writer was looking at this "down-and-out junk pile" smoothly and almost noiselessly carrying 2200 kw. of the peak load within three minutes after the compressed air had been turned on to start the engine. Far from being a junk pile, the engine is in the finest sort of condition and runs every night with the reliability and unobtrusiveness of a well kept Corliss engine. The rumbling of the big two-to-one gears and a subdued "chug" of each valve as it operates are the only evidences of its activity when one is not looking at it—unless one happens to look at the meters connected to the alternator. During an hour's observation one night and nearly two hours another night, the engine after-fired once, indicating a missed ignition; there was no other manifestation of irregular operation.

The chief operating engineer of the Georgia Co. states that the trouble given by the engine at the beginning was crankpin heating, due to the use of an unsuitable babbitt composition for box linings. After the source of trouble was identified, a softer babbitt was put in the crankpin boxes and there has been no trouble whatever since that change. The reports of cylinder cracks, premature ignitions, etc., are characterized by the chief engineer as being absolutely without foundation in fact.

Refrigeration Department

Principles and operation of ice-making and refrigerating plant and machinery

Blowing Off Heads of Ammonia Cylinder

By R. H. Roark

A short time ago the writer visited an ice-making plant where an unusual accident had occurred.

The equipment partly consisted of a Corliss-engine-driven refrigerating machine, with two vertical single-acting ammonia cylinders of the false-head type. The factory was not operated for three or four months in the fall and a few days before my visit the owners decided to test the ammonia piping and put the plant in operation. The engine was started, with the throttle "barely cracked" (?) and the engineer had walked across the room to the ammonia receiver, when there was a loud report, followed a few seconds later by another.

When the machine was stopped it was found that the heads of both ammonia cylinders had been blown off and broken into fragments. All of the studs were broken off, but the cylinders were apparently uninjured. A 2½-in. extra-heavy flange union was broken by the flying pieces of metal and one of the cast-iron water jackets was broken, presumably by falling fragments of the cylinder heads.

The regular engineer usually neglected to close the discharge stop valves when shutting down the machine and he was careless about seeing that they were open when the machine was to be started. An engineer was hired to assist him who followed a different procedure; he always closed the stop valves when the machine was not in operation. On this occasion the new man had closed the valves without notifying the regular engineer, who started the machine after a careless examination.

This accident was rather unusual in that both heads were blown off. I have heard of several accidents when one head was blown off, but in these cases the engineer had succeeded in stopping the machine before the other head gave way.

This accident points out two very important lessons to engineers: First, that no engineer should make any changes in the usual methods of operation without notifying the engineers working with him. Second, one should always be sure before the engine is started that the machinery attached is ready for operation. While this is a very simple precaution, I have known of several cases where experienced engineers have started up ice machines without first seeing that the discharge stop valves were open.

In one instance, the pressure in the cylinder caused leakage at the joint between the cylinder and cylinder head, this leakage being so great as to attract the attention of the engineer, who closed the throttle in time to save the heads and the charge of ammonia, besides the loss that would be caused by a shutdown in the middle of the summer.

In another case, the steam pressure was rather low and the engineer was unable to start the machine. On investigating, he found that the discharge stop valves were closed and the suction stop valves open.

At another plant the engineer was not so fortunate; he lost his head and opened the throttle wide and jammed it so tight that it was necessary to use a wrench on the valve-stem wheel in order to close the valve. The fireman stopped this machine by closing the main stop valve in the steam main.

Several years ago a similar accident happened that was really a blessing in disguise, as it served to give the owners of the plant a scare that they will never forget. This was a small factory and the owners were also the engineers. The boiler was a lap-seam affair of uncertain age and pedigree and was adorned with a safety valve that was rusty, corroded and otherwise disfigured, but it was undoubtedly the strongest part of the outfit. The engine room equipment contained a double-acting refrigerating machine driven by a Corliss engine that was about twice as large as was necessary. As the safety valve was known to be worthless the fireman was cautioned to never let the steam pressure exceed 80 lb., which was supposed to be the safe working pressure.

All went well until one day it was necessary to stop the machine for a few minutes and the engineer called the fireman to assist him in making an adjustment of some part of the engine. After it had been stopped a short time the engineer stepped into the boiler room and was horrified to see that the steam gage indicated a pressure of 125 lb. Rushing to the engine he quickly opened the throttle, hoping to reduce the boiler pressure to normal. The machine made a few revolutions and then commenced to slow down. In desperation the owner-engineer spun the valve wheel, opening the throttle wide. After two or three more revolutions the connecting-rod on the compressor side of the unit pulled in two, as the discharge stop valves were closed and the rod was the weakest part.

The owner had a narrow escape, as he gamely faced the flywheel until he succeeded in closing the throttle, and was probably only saved from a flywheel explosion by the fact that the engine was running slowly when the connecting-rod gave way.

In the meantime the fireman was covering the fire with wet ashes and cinders from the ashpit and when this task was accomplished the crew retired to a safe distance to wait for the steam pressure to fall. This converted the owners; they installed a new safety valve and had the boiler inspected and insured before the plant was again put in operation.

Loss of Refrigeration in Brine Line

By G. A. Robertson

The following gives the results of a test to determine the loss of refrigeration in a 2½-in. brine pipe covered with brine-pipe cork covering of 2½ in. thickness. This pipe is about 3 ft. underground. The length of the line is 450 ft.

The test was conducted on Dec. 9, 1911, with an atmospheric temperature of 75 deg. F. There had been no freezing weather previous to the date of the test. Two high-grade registered chemical thermometers were used, graduated in tenths of a degree, the space between degrees being about ¼ in. Deep mercury wells were used and these were set well down in the brine pipe, fittings being placed in the pipe line for this purpose. One well was in the discharge pipe of the brine pump in the engine room, the temperature of which was 80 deg. F. The other well was located in a tee on a riser at the other end of the line, the outside atmospheric conditions being as stated above. A magnifying glass was used in reading the thermometers. A man was stationed at each thermometer and both were read at the same time. The readings, given in Table 1, were obtained.

After the 3 o'clock reading, the positions of the thermometers were changed; that is, No. 1 was put in No. 2 well and *vice versa*. This was done in order to account for any error due to the thermometers.

The revolutions of the brine pump were taken several times during the test and were constant at 37 r.p.m. It was a 7 and 6 by 10-in. double-acting steam-driven single Rielly pump. Before the test the pump was calibrated as follows: The discharge valve of the pump was closed, a pipe connection being made between the discharge valve and the pump. A valve was placed in this line, and was closed the amount necessary to maintain the same brine pressure (80 lb.) on the pump as was carried during the test. The suction was not changed. The pump was started and discharged the brine into a can placed on a platform scales. Two trials were made with the following results:

TABLE 1. THERMOMETER READINGS

Time	No. 1 thermometer in engine room, deg. F.	No. 2 thermometer at other end of line, deg. F.	Diff., deg. F.
1:45	18.4	18.7	0.3
2	18.5	18.8	0.3
2:15	18.5	18.85	0.35
2:30	18.5	18.85	0.35
2:45	18.55	18.8	0.25
3	18.55	18.8	0.25
3:15	18.45	18.85	0.4
3:30	18.55	18.85	0.3
3:45	18.55	18.9	0.35
4	18.55	18.9	0.35
4:15	18.5	18.85	0.35
4:30	18:45	18.8	0.35
		Average =	0.325

On the first 382 lb. of brine per minute were pumped, and in the second trial 380 lb., making an average of 381 lb. In both trials the pump made 28½ r.p.m. and thus averaged

$$\frac{381}{28.5} = 13.37 \text{ lb. per rev.}$$

The density of the brine was 75 deg. salometer at 60 deg. F., and the specific heat was taken at 0.854. The calculation for tons of refrigeration was made as follows:

$$\frac{\text{Lb. of brine} \times 1440 \times \text{temp. diff.} \times \text{sp.h.}}{288{,}000} =$$

tons of refrigeration per day of 24 hr.

At 37 r.p.m. the pounds of brine pumped per minute would amount to 494.7. Substituting in the formula gives

$$\frac{494.7 \times 1440 \times 0.325 \times 0.854}{288{,}000} = 0.686 \text{ ton}$$

The heat transmission coefficient based on this figure is about 0.5 B.t.u. per square foot of outer pipe surface per hour per 1 deg. F. difference of temperature.

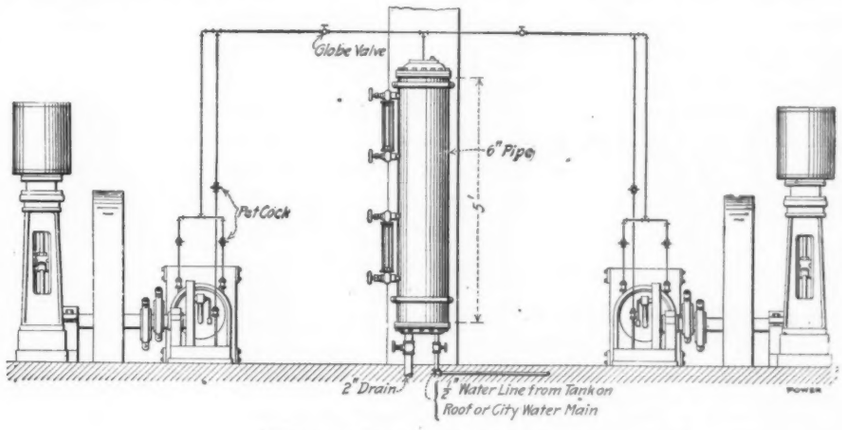
In making a test of this kind it is absolutely necessary that the brine be kept at a very nearly constant temperature; otherwise the readings will be very irregular. The temperature of the atmosphere about both thermometers should be about the same and the thermometers should be set down in mercury wells far enough to fully cover the bulbs. The mercury wells should be set well down in the brine.

Inexpensive Oiling System

By J. H. Stretton

A short time ago I was employed in a refrigerating plant which contained a simple yet effective oiling system. The engines were Corliss, tandem-compound, one right-hand and one left-hand, both being direct-connected to vertical ammonia compressors.

The oil reservoir was clamped to a reinforced-concrete column, and the distributing pipes extended either way over the engines. The illustration shows the arrangement. It may be noticed that oil cups are used, but are not necessary, as the small pet-cocks can be used to regulate the feed. When oil cups are used they act as an auxiliary reservoir in case the system becomes temporarily out of order, the oil cups being then filled by hand. Their use also allows a little more time when filling the main oil reservoir. The system showed in this case a great saving over the old method of filling by hand and costs practically nothing to operate, no pump being needed. The amount of water used is equal to the amount of oil drawn off.



Arrangement of Oiling System

This arrangement has advantages over the gravity feed or the pressure system, as the oil reservoir is down on the engine-room floor and is always in sight instead of being on the roof and requiring to raise the oil to the reservoir, as in the gravity system. A pump is also necessary with the pressure system.

To refill the reservoir, shut the ½-in. valve in the water line, open the 2-in. valve in the drain and remove the plug from the top. When the water has drained out, close the drain valve and fill the reservoir with oil. Then turn on the pressure and the fresh supply will be ready for use at the various points requiring lubrication.

In Switzerland, water power is conserved and utilized to such an extent that in some towns not an ounce of coal is used. Power, light and heat are furnished by water power.

LETTERS

Making Chloride of Calcium Brine

W. L. Keil gave, in Power of Dec. 12, a description of a home-made outfit for making chloride of calcium brine. The next time Mr. Keil wishes to make this brine I would advise him to dump the chloride of calcium right in the brine tank, and he will find that it will melt there just as fast as in the barrels. This may be done when making new brine as well as for strengthening weak brine. In the latter case the brine is generally cold, but the chloride of calcium dissolves just the same. The reason is that chloride of calcium has a strong affinity for water, and will readily dissolve when coming in contact with it.

Chloride of calcium is nasty stuff to handle, and to get it where it belongs the quickest and easiest way is to break it up to the size of run-of-mine coal and dump it in that state right into the brine tank. In 10 to 15 hr. it will have melted away.

Common salt dissolves in barrels or boxes faster than chloride of calcium with water run over it, and the mixture stirred as in making brine, but if in its natural state it is dumped in old brine or water for making brine, it is liable to cake in a solid lump and never dissolve.

Fred Kaiser.

Sanford, Fla.

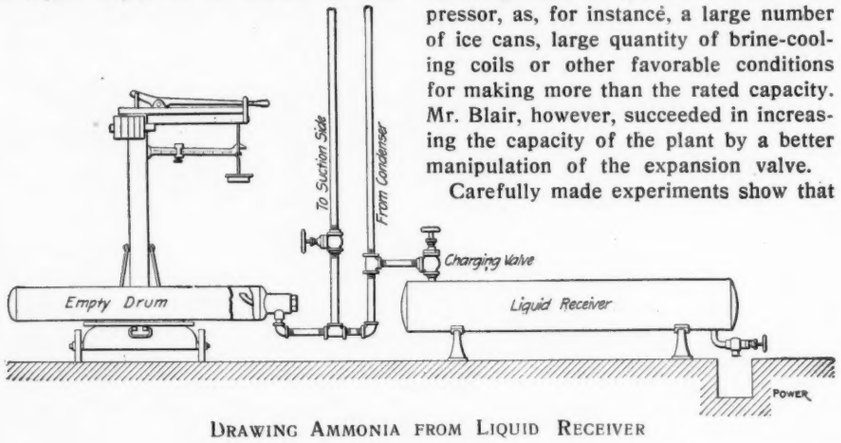
Drawing Ammonia from Compression System

In the Feb. 6 issue the question was asked, how can the ammonia be taken out of a compression plant without losing any of it? While the answer is a good one, my experience with the same problem may be of interest.

To draw a charge of ammonia from the system, connect an empty ammonia drum to the charging valve. Put a tee in the pipe between the charging valve

and the drum and from the branch of the tee run a pipe to some connection on the suction side of the machine if possible. Insert a valve in this line. The curved pipe inside the drum should face upward, as shown in the sketch. Place the drum on a platform scale when all connections are made. Then open the drum valve and the charging valve and allow the liquid to flow from the receiver to the drum. By watching the scale beam it will be seen that the ammonia soon stops flowing. This is because the gas forming in the upper part of the drum has equalized the pressure.

Now shut off the charging valve and open for a second only the valve in the branch line to the suction side. This will allow the gas to pass off and when the charging valve is opened again the liquid will start flowing. This operation should be repeated as often as the flow of liquid stops, but be careful and not



DRAWING AMMONIA FROM LIQUID RECEIVER

get any more ammonia in the drum than it contained when new. If it is not convenient to make the connection to the suction side of the system, the gas can be allowed to escape to atmosphere as the amount would not be very great. In this manner the system can be completely emptied.

MARTIN MCGERRY.

Holley, N. Y.

Temperature of Ammonia Discharge Pipe

I noticed in POWER of Jan. 23 Bennett Story's letter on the temperature of the ammonia discharge pipe, and also how he had increased the capacity of the plant. In my practice I have paid little attention to the discharge temperature as long as I could keep the compressor working well. I feel safe to say that there are more engineers who keep their discharge temperature too low than otherwise. I do not believe in trying to make the compressor do its own work and the condenser's also.

I wish Mr. Story had given a few more details of the kind of plant he has and other conditions. He states that he runs the discharge temperature lukewarm. This is an unknown quantity. Webster gives it as moderately warm, not excessive, so that it might fit quite a range of temperatures. The article by Mr. Blair, in the Oct. 31 issue, in which he says he increased the capacity of his plant from 33 to 50 per cent. by closing the expansion valve, makes me think of the story of the man who wanted to buy two stoves because he was told that one would save one-half the fuel.

FRANK H. CORDNER.

Bradford, R. I.

In his letter Mr. Story does not say that he increased the output of the plant by a particular manipulation of the expansion valve. He says that they made 40 tons of ice with an ice-making system rated at 30 tons and 26 tons with a system rated at 20 tons. This may have been due to causes other than those resulting from the operation of the compressor, as, for instance, a large number of ice cans, large quantity of brine-cooling coils or other favorable conditions for making more than the rated capacity. Mr. Blair, however, succeeded in increasing the capacity of the plant by a better manipulation of the expansion valve.

Carefully made experiments show that below a certain temperature of discharge, which temperature varies for different sets of suction and discharge pressures, the capacity of an ammonia compressor for pumping gas decreases. To secure the best average results the discharge temperature should be kept well above this limiting point to allow a reasonable fluctuation in the quality of the suction gas without reaching extreme conditions either way and thereby impairing the efficiency of the plant.

For 185 lb. condenser pressure the average discharge temperatures should be about as follows:

	Deg. F.
25 lb. suction pressure	215
15 lb. suction pressure	250
5 lb. suction pressure	275

In a general way it might be said that the proper temperature of discharge for an ammonia compressor is the theoretical discharge temperature for the pressures under consideration, the suction gas being saturated. The decrease in the capacity of the plant when the temperature of discharge is low, is due to the excessive quantities of liquid present in the suction gas, which decreases the pumping capacity of the machine per revolution.—EDITORS.

Ammonia Packing

I see in POWER of Feb. 20 that H. G. Gibson has had trouble in packing the piston rod on his ammonia pump. I know how to sympathize with him for I had tried to pack a similar rod for a couple of years before I won out. Let him stop entirely the use of fibrous packing and use instead a ring of good rubber 3/8 in. thick, then a ring of babbitt metal 1/8 in. thick, another rubber ring, then a babbitt ring and so on until the box is filled on both sides of the lantern.

H. A. GREENE.

Boston, Mass.

Take good hemp packing of the correct size, neither too large nor too small, and wind it around the rod to be packed as many times as there are rings required, care being taken to keep the coils tight and pressed close together. Now draw a straight line from the end across the coils of packing and parallel with the rod. Take the packing off the rod and cut with a sharp knife at each mark. Take the pieces cut, which should be of the correct length, and tie a string around them, making a small bundle. The bundle should be soaked in good ice-machine oil over night, and then pack the pump, using no other lubricant in the stuffing-box.

R. P. WILCOX.

Chicago, Ill.

After using fibrous packings for several years and having the rods leak at the end of a few days, I tried several methods and combinations of packing with the result that I spoiled the rod.

I had always used a pure gum ring as a condenser-tube packing, and decided to give it a trial on the pump. I have found this packing satisfactory. It must be supplied with oil, and in our case a swab was placed on the rod and fastened so that it could not travel. An oil cup was tapped in at a convenient place and one or two drops of oil per minute were allowed to drop on the swab.

This method can be employed most anywhere, and while the first cost of the gum ring is about twice as much as the fibrous ring, the amount used is less, and the rod is saved.

H. H. BURLEY.

Brooklyn, N. Y.

We have had exactly the same trouble as Mr. Gibson. We used the same kind of packing, the solid rings and the diagonally split rings alternately, but with no success. The packing would crumble. We concluded that the packing was too soft and so tried a tougher packing which comes in long spirals and is made with alternate layers of rubber and canvas.

It is giving us entire satisfaction and I would advise Mr. Gibson to try it and let us hear further from him.

FREDERICK M. PERRAS.

Mansfield, Mass.

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POWER

Engineering in the South

As has been often said, "the world moves rapidly," but it is impossible to form an adequate idea of just how fast it does move without inspection at close range. That is why at frequent intervals a member of our editorial staff buys a multicoupon railroad ticket and, taking his notebook and pencil firmly in hand, migrates north, east, south or west, returning with a vastly broadened knowledge of the section of country traversed, together with particulars of power-plant practice contributed by engineers of that section.

The last time, the editor went into the "Sunny South," and some of the results of his pilgrimage are presented in this issue. These articles, however, do but faint justice to the astonishing development that has characterized the past decade in that section. Power plants formerly consisting of a few belted units and return-tubular boilers have grown into equipments of turbo-generators supplied from water-tube boilers; picturesque falls and rapids which were formerly regarded only as scenic attractions are now the primary dependence of economic manufacturing, well lighted streets and enhanced domestic comfort in near-by cities.

Ten years ago the populace of New Orleans crossed the streets on planks during heavy rainstorms and even then did not "land" dryshod; drinking water was laden with typhoid and yellow-fever germs during certain seasons, and open sewers were a constant menace to health. Today, the surface water is taken off and forced out into the lakes by large motor-driven pumps, the city operates a huge water-purifying plant, and practically all domestic refuse is pumped away through closed sewers. The power equipment of the drainage system is described elsewhere in this number.

A very interesting feature of practice in one of the large central stations of the South is the operation in parallel of high-tension alternating-current generators driven by four different types of prime mover; a brief outline of this is given in the Electrical Department. At another large station most of the units are operated noncondensing in order to utilize the exhaust steam for commercial heating throughout the business district. A small station in Georgia is operated by gas engines supplied from producers which are charged with pine blocks and cypress roots and stumps.

These and other evidences of the engineering development of the South are presented in the present number. Even the citation of all such examples of Southern modernity would be utterly impractical. Our efforts, therefore, have been restricted to the discussion of a few representative installations, as diversified as possible in character. These suffice to show that in engineering, as in other matters, Dixie-land, far from being under the domination of the hookworm, is thoroughly alive to her opportunities.

The Dividing Line

It is unfortunate that there is so little available information as to the actual cost of steam power-plant operation. In the controversy between the advocates of the isolated plant and those interested in the extension of central-station service no authentic figures are given, and when an owner is compelled to make a choice between the two systems it is usually the best talker who gets the business, regardless of the facts involved in the case.

There is, of course, some dividing line in the power requirements above which the isolated plant will give the cheaper service and below which it will be profitable to buy power.

There are several factors that enter into the power-plant problem, not the least of which is heat. In many industries this is needed the year round, and in all northern latitudes for at least half of the year, and the ratio of fuel required for heat to that necessary to furnish the required power should be considered.

The cost of labor in a small plant is proportionally higher per unit of output than in the large one. A steam-power electric plant of fifty kilowatts capacity will require the employing of an engineer and a fireman, which would make the labor cost alone approximately one cent per kilowatt-hour. Coal and fixed charges would probably increase this to nearly four cents for a constant load for three thousand hours per year and it might easily be double this for a plant where the maximum output is reached only during the lighting period.

For a plant of one-half this capacity the total labor cost could not be much less, but the cost per unit of production would be doubled and would reach a price which would be readily met by the central station.

As the plant increases in capacity the cost of attendance per unit of output rapidly decreases, and in many large plants the labor cost per kilowatt-hour is an insignificant fraction of a cent.

In the central station there are large distribution expenses to be met which do not obtain in the small plant. There are some at or near the fifty-kilowatt line where the costs will balance and above which the isolated plant will have the advantage, while below this line purchased service will be the cheaper.

The calls for steam for purposes other than for power will have a modifying influence and may in some cases make even the smallest load a profitable one to carry.

Structural Errors

It is to be regretted that engineers and power-plant men in general are so often compelled to labor in small spaces where it is almost impossible to accomplish the work to be done without loss of temper and very often minor injuries to the body. It is true that the ability to meet such conditions is what is required of an engineer, but that is to his credit, and does not justify the conditions that call for the exercise of his skill in this direction.

Of course, it is not always possible to prevent the existence of such places in power plants, and it is also true, once in a while, that the architect is not to blame. Where space is very valuable, the architecture of the plant must be adapted to that condition. In such cases the engineer must tolerate the discomforts and hardships imposed, and accomplish his task as best he can.

Unless one has experienced the work of firing in a poorly ventilated boiler room during a hot day, when the load is usually heavy, it is difficult to imagine its discomforts. Then, too, there are those small, cramped quarters where the auxiliaries are often located, and where making repairs or adjustments is well nigh torture.

Wherever conditions will allow it, the design of a power plant should be such as to give space enough around each piece of machinery to facilitate attendance and repair instead of aiming in the opposite direction, as the conditions in many plants would suggest had been done.

Possibilities of a Coal Strike

Engineers and plant owners who have had their ears to the ground feel that a strike among the coal miners is not only possible but probable. That the trouble will extend to the entire bituminous coal fields in the United States is doubtful, but that the anthracite miners will strike Apr. 1 is almost a foregone conclusion.

The situation is intensified because the existing agreement between the anthracite and bituminous coal miners and the operators expires at the same time, Apr. 1.

A strike means much to all concerned. Not that there will be a suspension of business, such as England has experienced, but if the users of the smaller sizes of anthracite coal cannot obtain a sufficient supply, bituminous coal will be substituted at an increase in price and with its accompanying smoke production.

Those who have had the foresight, and whose circumstances have permitted, have stored coal in anticipation of a shortage. Those who have not the facility for storing fuel will find it necessary to modify furnace and grate conditions and make arrangements for burning soft coal, of which there is an overproduction.

In the event of a strike it is doubtful if it extends over a long period. Public sympathy is not with the threatened suspension of mining because the miners demand a 20 per cent. minimum increase. This practically means a wage of $3.50 per day and an increase of about 65 cents in the cost of domestic coal per ton, will come out of the pocket of the consumer.

A strike will mean an increased consumption of soft coal and an increase in cost. This will ultimately result in a higher cost of living which, in the minds of the public, is altogether too high as it is, without additional burdens. A strike to succeed must have the sympathy of the public; without that, it is bound to fail.

Although indications do not point to a long-drawn-out strike, a big reserve supply at the rear of the boiler plant will materially assist in preventing a shutdown and suspension of business due to failures of cargoes to arrive on time.

Wave Motors

Another wave motor is announced on page 443 of this issue. The problem of converting the energy contained in the moving mass of water which constitutes a wave is rather a financial than a mechanical one. There are many ways of doing it, but none has met with any extensive adoption because the interest on the cost of the installation would more than pay for coal enough to produce the derivable power.

It is often questionable whether it will pay to dam a river and develop the power of a continuous water supply. The same careful consideration of the relation of interest and depreciation charges to power producible should precede any investment in a wave motor. The denominator is apt upon analysis to be unexpectedly small.

An entrance examination is proposed for candidates for admission to the Institution of Mechanical Engineers of Great Britain. Such examinations have long been in force in the Institution of Civil Engineers and are proposed for the Electrical Engineers. The rules are flexible enough to permit the admission of a man of sufficiently wide practical experience, notwithstanding a lack of institutional education. So far as we know, no such examinations are required in any of the American national professional societies in the engineering field.

Readers with Something to Say

A letter good enough to print will be paid for. Ideas, not mere words, wanted

Working a Bag Out of a Boiler

I was recently called upon to work a bag out of a boiler. After examining the boiler, I found the bag to be 17 in. in diameter and 2¼ in. deep. I drilled a hole in the center, to allow for take-up and cleaned the plate off nicely both inside and outside, and then heated the plate to a red color, placing fireclay mixed to a putty in the center so as not to overheat at that point. I was very careful not to overheat the plate at any point.

Then, with a smooth face flatter and a medium-size sledge, I drove all around the center, working the bag up. Several heats were necessary to get the plate back to the original shape. I used a straight-edge to determine when the bag was out and the plate in shape. I drove the plate so as to bow a little inward.

After this was accomplished, I reamed the hole out, which had partly closed and heating a rivet of proper size, placed the head on the inside and riveted up the hole. I then gave the boiler 90 lb. per square inch of cold water test and hammered lightly on the repaired boiler, which showed no stress or strain. After dropping the water to a proper level, the boiler was fired up, the job being perfect in every respect.

E. L. MORRIS.

Salem, Va.

Centrifugal Pump Trouble

We are pumping some 2500 gal. of water per minute carrying about 8 per cent. solids through a 10-in. pipe line 2000 ft. long, and raising the water and solids some 70 ft. To do this, at times we have three 10-in. centrifugal sand pumps in the line. One pump is placed at the lower level, the other two are placed at such locations as to divide the head equally between the three pumps.

We have had considerable trouble in the breaking of the upper pumps when starting up or shutting down, due to the separating and closing again of the column of water in the line. Of course, if all three pumps could be controlled simultaneously, the trouble would be eliminated. One solution is to discharge the water from the lower pump into a small reservoir or sump hole near the suction of the upper pump and pick it up again. This, however, necessitates a complication of suction and priming connections and foot valves which it is desirable to avoid.

We have tried check valves in the line to hold the column of water from flushing back toward the lower pump. This has proved of no avail as the check valve holds a stationary column of water on its upper side which has enough inertia to cause immense pressure due to impact when the lower column hits it. We have also contemplated installing relief valves at suitable points in the line, but the difficulty of keeping the valve seats, and other parts in good condition due to sand, rock, etc., in the water has deterred us heretofore. We are now contemplating placing air chambers at the discharge of the pump to cut down the jar due to the making and breaking of the column of water in the line.

Possibly our experience may be of interest to POWER readers, and its discussion may be of benefit to those interested.

MILTON BAKER.

Plant City, Fla.

A Wave Power System

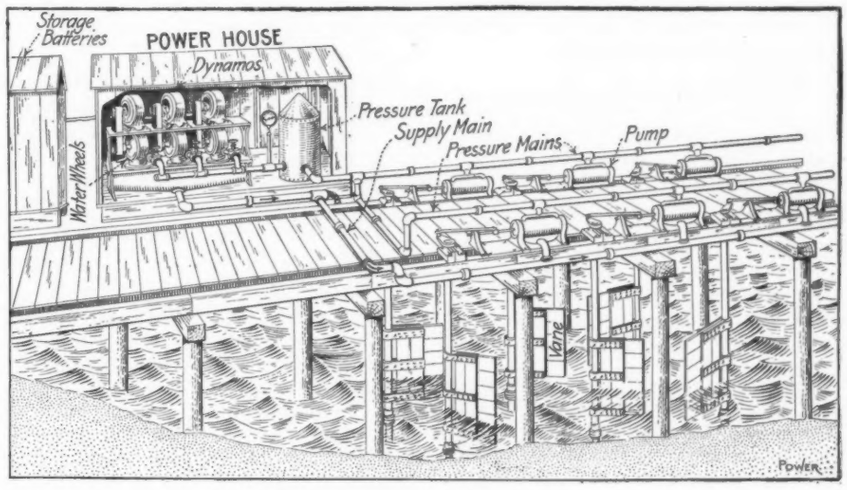
In a recent number of POWER, there appeared an exhaustive article by Franklin Van Winkle, "Power Derivable from Ocean Waves." He states that the possibilities of obtaining commercial power from a wave motor are founded on a very narrow margin. I will go farther than that and state that they are practically out of the question. Mr. Van Winkle has made the same mistake that all inventors and engineers have made ever since the history of the wave-motor question began, viz.: That of considering the problem from the standpoint of the individual motor.

The inclosed prospectus will introduce the question in an entirely new light, as it deals with the problem from the standpoint of a system.

F. M. REYNOLDS,
Secretary,
The Globe Wave Power & Electric Co.
Long Beach, Calif.

[The accompanying figure, taken from that shown in the prospectus, serves to illustrate the principle of the "system" mentioned.

The submerged vanes actuate the pumps which force water into a pressure tank from which the water flows to the waterwheels that run the dynamos.—EDITORS.]



THE NEW WAVE-POWER SYSTEM

Cut the Boiler Shell

The danger of using sharp tools in cleaning the inside of a steam boiler was proved to me a short time ago.

The boiler in the plant where I have been employed as general mechanic for two years, had for four years been equipped with a boiler scraper, making it almost if not quite impossible for the engineer to get inside under the tubes to do the cleaning properly.

The damage must have occurred over four years ago, and before the scrapers were put in. The engineer on firing up the boiler one Monday morning noticed a small leak in the rear sheet, about 3 ft. from the rear head, at the point where the brace from the head is riveted to the sheet. At 40 lb. pressure there was a stream of water and steam as large as a lead pencil pouring into

the combustion chamber. The engineer at once pulled the fire and began to cool the boiler.

As soon as it was cool the scraper was removed and thrown away. Seven tubes were then removed when it was found that the crack was directly under the heel of the brace. The brace was then taken out and in place of a crack we found that the shell had been cut some time by a sharp tool as it had been driven under the brace to remove the hard scale.

The cut started from each side of the brace, which was 4 in. wide, at about 1 in. back from where the heel of the brace met the iron. It extended at a slight angle to the rear, one cut overlapping the other about ¼ in., and from a scratch at the beginning to fully ¼ in. deep where they met in the center.

The inspector claimed it had been caused by the expansion and contraction of the metal, but as there was a metal chip lying over and partially closing the first cut where they came together, it must have been caused by driving something under the brace.

Six ½-in. holes were drilled and tapped, copper plugs put in and headed over nicely; the brace and tubes were replaced after they had been trimmed and welded, and when the boiler was put into commission again it was as good as ever.

It is a good plan not to use sharp tools or tools with sharp corners around boiler shells in scaling; but if it is necessary, be careful where the edge or corners of the tools go, or a leak, if not worse, may result.

A. H. STRONG.

Los Angeles, Calif.

Steam and Temperature Charts

The accompanying charts from a recording steam gage and a recording flue-gas thermometer graphically illustrate the importance of proper construction and operation of boiler furnaces. These charts were obtained from an 18-ft. by 72-in. return-tubular boiler, set in a brick furnace. It was operated 12 hours daily, at two-thirds of its rated capacity.

The fire was stopped at about 5:50 p.m., as shown by the chart, Fig. 1. The steam pressure was 115 lb. at 5:45 a.m., there having been no fire in the furnace during the intervening 12 hours.

Oil is used for fuel and about two minutes before the engine is stopped for the night the supply of steam and oil to the burner is shut off and the ashpit doors and damper are closed, but the feed pump continues to run. As soon as the engine is shut down the main stop valve on top of the boiler is closed, the feed pump being supplied with steam from a small auxiliary line.

The feed pump is permitted to run until the boiler contains about three gages of water, which pulls the steam down to 95 lb. The feed pump is then stopped, all valves in the feed line are closed and the steam is shut off from the auxiliary header.

When the feed pump was stopped at 6 p.m. the steam pressure commenced to rise, caused by the boiler absorbing heat from the hot brickwork of the furnace, until at 7 p.m. the safety valve opened. The fall of pressure between 7:15 p.m. and 5:45 a.m. was regular and gradual, being caused mostly by the radiation of heat from the boiler and furnace.

The bulb of the recording flue-gas thermometer is inserted in the smokebox directly above the tubes, and the thermometer chart, Fig. 2, shows that the temperature in the smokebox fell at a rate corresponding to the fall in steam pressure.

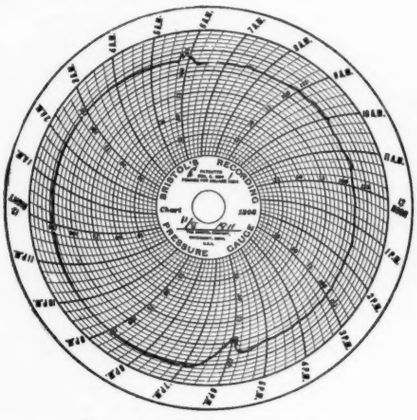


FIG. 1. STEAM CHART

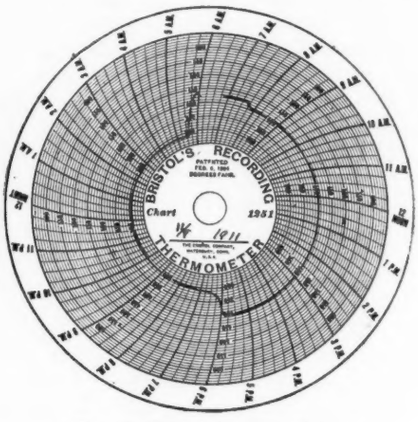


FIG. 2. TEMPERATURE CHART

I have seen plants where the steam pressure would fall to zero a few hours after the fuel oil was shut off, owing partly to leaky steam and water valves, but principally to a leaky furnace setting and leaky ashpit doors and dampers, which permitted cold air to be drawn in through the tubes, cooling the water and condensing the steam in the boiler.

This is poor economy, for fuel is wasted in heating the furnace and raising steam to the working pressure in the morning.

J. T. WILLIAMS.

Brownsville, Tex.

Effect of Air in Steam

I would like to have some practical and theoretical opinions as to the effect air in steam may have on the vacuum in a condenser.

Would not a leaky suction on a lifting boiler feed pump affect the vacuum more than a leaky condenser pump on account of the higher temperature of the air coming from the boiler?

W. A. FULLGRAF.

Collinsville, Okla.

Repairing a Cracked Cylinder Head

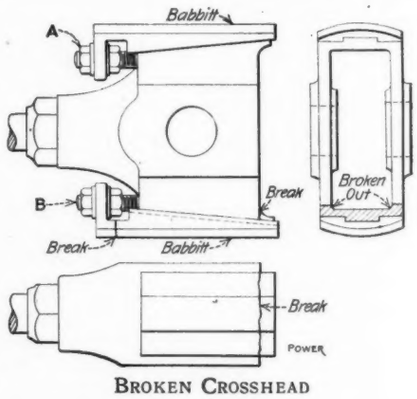
Cylinder heads of pumps become broken sometimes. A simple way to repair one while waiting for a new part can be accomplished in the following manner: Remove the broken head and cut a piece of galvanized iron the exact size of the head and place it between the packing and cylinder head. Then tighten up the stud nuts holding the head, and the pump is ready for work, providing no further trouble exists.

STANLEY RADCLIFFE.

Laurel, Md.

What Broke the Crosshead?

The accompanying sketch shows a very peculiar break of a crosshead of a 10x 30-in. Corliss engine, belted to two 35-kw. generators. The engineer had packed the piston a few minutes before starting up for the night's run. He started up and the engine had no more than gotten up speed when there was a loud report. It was found that the crosshead and bottom shoe were broken, as shown. When



BROKEN CROSSHEAD

the engineer shut down he found that both guides were hot and the crosshead shoe was out on the floor.

I do not understand what caused the trouble as the nuts *A* had not been taken up in six months. The engine has been in operation about 10 months and ran at 90 r.p.m.

The bolt *B* was bent up toward the piston, but was not broken, and both nuts were tight. The crosshead was patched, a brass shoe made and put on and it has been working very nicely since.

Can someone who has had a similar trouble and found out what caused it let me know?

H. R. WILLIAMS.

Grand View, Tex.

To Remove Burnt Oil

For several years I have used the following recipe for removing burnt grease from the bright parts of engines, such as cylinder heads and valve bonnets.

Dissolve about 5c. worth of oxalic acid in 1 qt. of distilled water and apply with a rag while the metal is either hot or cold.

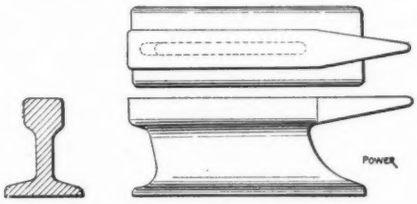
Some engineers are troubled by oil sticking to the sight-feed glass on lubricators. One remedy is to clean the glass thoroughly and refill it with glycerin. It will not only keep the oil from sticking, but the oil can be fed in small, round drops. Keep the packing nuts tight and fill the lubricator each time before it runs dry, and the glycerin will stay in the glass indefinitely.

D. E. ADEN.

Wilburton, Okla.

Rail Bench Anvil

While visiting a neighboring plant my attention was attracted to a small bench anvil. It was made from a piece of steel



ANVIL MADE FROM A PIECE OF RAIL

railroad rail tapered at one end as shown.

J. H. STRETTON.

Los Angeles, Calif.

Low Water in Boiler

In a plant where I was acting as night engineer, there was a battery of five boilers. On entering the boiler room one night, I found the head fireman asleep, and his helper firing in his place. I looked at the water gages and could see no water in No. 4 glass. On trying the column and getting no water, I ordered the helper to pull the fire while I went behind the boiler to open the back door. While I was doing this, the fireman awoke and turned the water into the boiler. It seemed to me that the boiler jumped an inch from the floor; there was a muffled report, and the helper said the steam gages went up 5 lb.

The water put out the fire, and on examination I found 45 flues sprung in the tube head. The feed water entered the boilers at 195 deg. F., and it is my opinion that the boiler would have exploded if the tubes had not sprung and relieved the pressure.

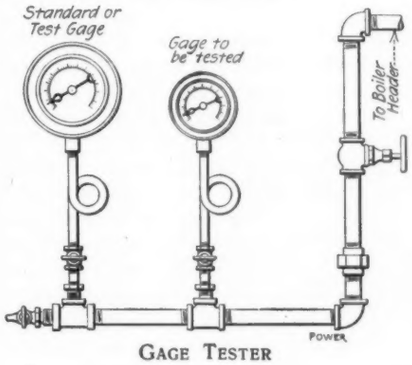
I do not want any more conclusive proof that water in an empty boiler will cause an explosion.

V. C. WOOD.

Copenhagen, N. Y.

Gage Tester

There are 50 odd steam, air and water gages in constant use about my plant, and I keep them accurate by testing with a home-made gage tester, which is always ready for use. It is connected up as shown in the illustration.



GAGE TESTER

The water gage is tested every two or three months by the same boiler inspector. I can test gages at different pressures by throttling the valve in the steam line and opening the drain cock at the end until the desired pressure is obtained.

With this device I keep all gages in perfect working order with very little trouble and expense. The pipe can be connected to the boiler steam header or to a water tank if the pressure is enough.

J. W. DICKSON.

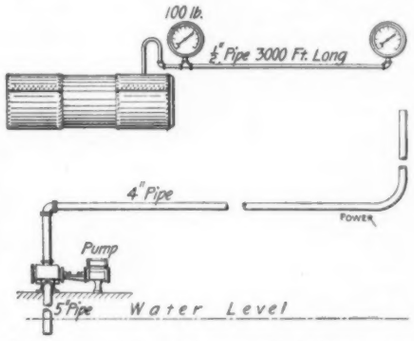
Memphis, Tenn.

Three Pressure Problems

There are three problems which I would like to have the readers of POWER solve. The first is, What is inside of the spring of a steam gage, steam, air or water?

Second. With 100 lb. pressure (gage) on a boiler, what pressure would a gage show when placed 3000 ft. away on the end of a ½-in. pipe with the pipe level, no leaks, no outlet, and the gages at the same elevation with the pipe full of water? (See Fig. 1.)

Third. A 10 and 6 by 12-in. duplex, outside-packed, plunger steam pump is fitted with a 5-in. suction pipe and a 4-in. discharge pipe. The steam at the throttle is 100 lb. and the suction lift is 5 ft. The head on the discharge pipe is 5 ft.; that is, the end of the pipe is bent to an angle of 90 deg., or at right angles to the horizontal pipe. What length of pipe would be required so that when placed level with the open end up in the air or vertical, no water would flow from the end with the pump running with a wide open throttle? The slippage is assumed to be 20 per cent. and no allowance is made for friction of the pump pistons. (See Fig. 2.)



FIGS. 1 AND 2. PIPING OF GAGES AND PUMP

The first question has been discussed all winter at an engineers' association and is still unsettled.

Question two is asked to learn what, if any, difference in pressure there would be between the steam gage on the boiler and one in the engine room some distance away, as is the usual case.

Question three is asked to determine whether a pipe could be long enough so that the 10-ft. static head plus the friction of the open-end pipe could increase the load enough to overcome the 100 lb. steam pressure.

J. C. HAWKINS.

Hyattsville, Md.

Cut Engine Cylinders

A call came from a large power plant to a firm of engine builders to send a man to bore out a 32-in. cylinder. It was found that before reboring the cylinder it would be necessary to put on a patch, as the cylinder was cut entirely through at the top; the sides showed some wear but the bottom had hardly any.

A copper patch was put in and the cylinder was rebored. The engine was then put into service again and a sharp lookout kept for results. Some days afterward the cylinder head was again removed and signs of new cutting were apparent.

Several theories were advanced as to the cause of the trouble. The same kind of oil was being used in other engine cylinders running under the same general conditions, and steam was supplied at 160 lb. pressure, superheated to 480 or 500 deg.

A suggestion was made that turning a little off from the sides of the rings

to make them freer in the grooves might help matters. This was done and proved to be a remedy.

A similar case cost this same engine company a new engine cylinder, to replace one which was cut so badly in a short time as to require reboring.

After running some days, the same thing happened again, and the purchasers demanded a new cylinder; it was furnished.

Imagine their surprise when the cutting started again. Finally, the piston rings were reduced $^1/_{100}$ in. in width, and no further trouble was reported.

The cutting was done mostly on the head end and stopped about where the cutoff would occur at normal load. This was doubtless due to the fact that at the end of the stroke before the boiler pressure was admitted, the ring was free to expand, which it did. When boiler pressure was admitted, however, the pressure on the follower was sufficient to grip the ring, whose edge acted as a scraper until the pressure was cut off, which, becoming less, released the rings.

H. R. Low.

Moosup, Conn.

What About the Receiver Pressure

The accompanying diagrams were taken from a pumping engine which I think are about right. I would like to know

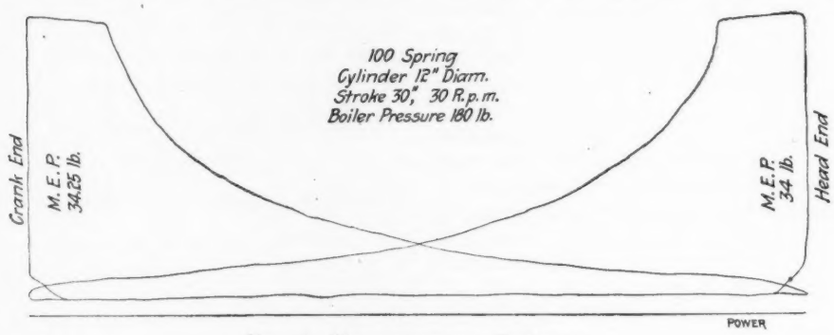


FIG. 1. HIGH-PRESSURE DIAGRAMS

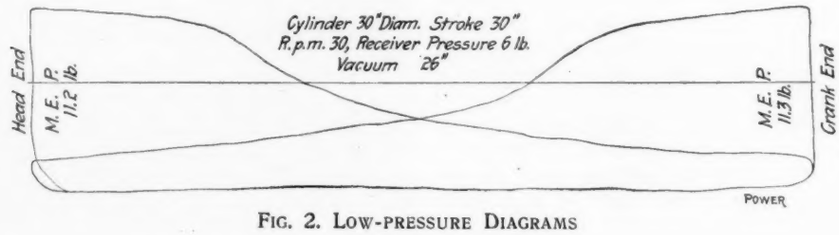


FIG. 2. LOW-PRESSURE DIAGRAMS

if any reader has any suggestions as to the receiver pressure carried, which is 6 lb. per square inch. Is equal work done in both cylinders?

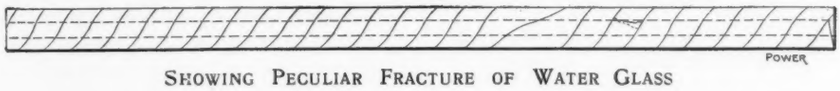
Notwithstanding that our engine runs very smoothly, it will be noticed that there is very little compression.

J. F. REYNOLDS.

Phoenix, Ariz.

Peculiar Gage Glass Fracture

The accompanying illustration represents a water glass recently removed from a boiler water column. The sketch



SHOWING PECULIAR FRACTURE OF WATER GLASS

shows the manner in which the glass broke, the spiral and the divisions being as near a duplicate of the actual glass as it is possible to make.

RICHARD SWARTZ.

Hot Springs, Ark.

Locating a "Screech"

I was installing a small high-speed engine and fan in the boiler room and having paid a visit to the maker's works to see the engine tested, I expected no trouble with it when starting up.

I arranged for a trial run immediately after stopping-time to make sure of a good send off the next morning. When I turned on steam, running the engine slowly, I also turned on an awful screeching. As the screeching synchronized with the stroke of the piston, I had the cylinder cover removed and an abundant supply of thick oil was poured in, but this did not improve matters.

The cover was again removed and the piston tested for clearance; using feelers I found a variation from 0.003 to 0.007 in., and concluded that an error of 0.004 in. would not cause such a noise. Then I removed the piston, and as the rings were somewhat stiff I had them relieved slightly on the inside.

As this made no improvement, I concluded that something was wrong with the piston or connecting-rod, and I had them out for a proper examination, but found them all right.

Although I had not located the trouble, I told the men to get the engine together again, but there was not the slightest improvement. With both hands on the valve wheel I turned off the steam and the screech seemed to vibrate along my arms. Upon removing the globe stop valve, I found the valve stem over which the disk fitted much too tight, the spinning of the disk setting up the screech which puisated with the piston-valve movement. This was soon put right and we made a good start in the morning.

I had saved $6 by purchasing that globe valve separate from the engine. On the other hand, I had to pay two pipe fitters and a fireman for the all-night work, and there were my own time and loss of sleep, a new suit, salve for various scalds and the coal I did not save that night.

F. P. TERRY.

Belfast, Ireland.

Damper Regulator

I would like to see the following questions discussed by the readers of POWER:

Is it economy to use damper regulators operated by steam pressure?

Is it not true that when a damper opens a poor fire is the direct cause and will this not cause the furnace to chill and produce a low percentage of CO_2? Further, would not a regulator operated by a CO_2 apparatus produce a greater saving than when operated by other means?

G. CLINTON SMITH.

Iron River, Mich.

Question Reference Book

I have experimented with index question books for some time and I am now trying a system that appears to me the best of which I have seen or heard. The book fits the vest pocket and gives a leaf 2½x4½ in. The paper is thin and can be used on both sides.

The questions are grouped and numbered; for instance, under "Boilers" I group "braces," "heating," "rivets," and so on.

Over the question I write in red ink where the answer may be found, as, for instance, POWER, Vol. 34, page 44.

Whenever I find a question, I make note of where I can find the answer, as this is much easier than writing out the answers.

L. N. WEBSTER.

Springfield, Mass.

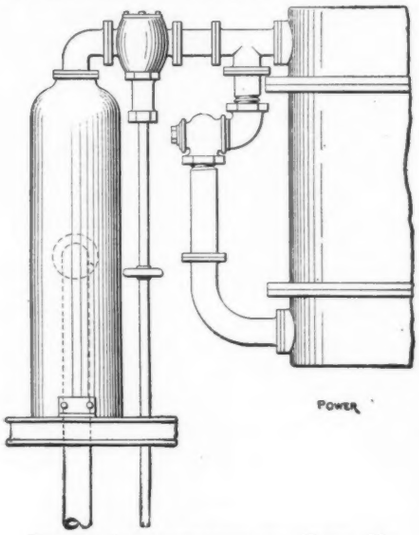
Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

What Cracked the Ell

In answer to Mr. Blessing's request in the Feb. 13 issue, I offer the following:

If the distance from the center of the tee to the center of the ell does not measure exactly the same as the openings in the cylinder, a slight strain would be caused in connecting up the pipe, and



PIPING ARRANGEMENT TO TAKE UP EXPANSION STRAINS

when expansion takes place instead of the expansion joint acting as a relief, it creates an increased strain, causing the ell to break.

If the measurements are correct, a longer expansion joint would remove the cause. I suggest, if the conditions will permit, that Mr. Blessing place the tee closer to the cylinder, breaking down with a close nipple and ell, making a swing joint as shown in the accompanying figure, and doing away with the expansion joint.

I had a similar case seven years ago, and the swing joint gave the desired relief.

EDWARD L. JOHNSON.

Brooklyn, N. Y.

In the Feb. 13 issue, H. R. Blessing wants to know why the ell breaks on a pipe which is supposed to be protected by an expansion joint.

An expansion joint will very often fail to operate in a position such as is shown by his drawing. The joint is not in a straight line between the two ends of the piping intended to be protected. Therefore, if the expansion joint sticks ever so little, the expansion will bow the pipe out enough to bind the joint so that it cannot slip no matter how much pressure comes on it. The greater the pressure, the harder it will bind.

Even if an expansion joint has lateral play enough to prevent its binding, it is often the case that the friction necessary to make it slip is greater than the force required to bend the pipe.

All pipe lines containing bends or elbows should be thoroughly braced in a straight line with the section containing the expansion joint in order that the latter will be forced to do its work.

FRED BOONE.

Davidson, Okla.

The sketch in Mr. Blessing's letter in the issue of Feb. 13 shows a receiver-separator approximately 10 ft. high mounted very close to the engine cylinder and rigidly fixed at the bottom so that its expansion would raise the outer end of the short upper connection, thereby forcing the expansion joint away from the cylinder and putting a bending moment at the point where the crack appeared.

When steam was turned into the cylinder, the expansion of the cylinder would tend to relieve the stress, or might even reverse it by lifting the cylinder end of the pipe higher than the receiver end. In any case, some bending force was applied as often as the cylinder was heated and cooled.

There is some evidence to show that cast-iron fittings slowly deteriorate when subjected to high steam pressures, especially if superheated steam is used and the temperatures are intermittent. Such conditions are likely to be found in plants of this size and it may be that deterioration of this sort was a contributing factor. Again, the engine when running has some vibration and perhaps some movement relative to the separator anchorage, which would contribute to the same effect

The remedy is to shorten the nipple above the expansion joint until this joint is as close to the tee as possible. This will decrease the amount of movement to take up.

G. M. WESLEY.

LaFayette, Ind.

In reply to Mr. Blessing's question in the Feb. 13 issue, I think the trouble is due either to crystallization because of vibration or more probably to unequal expansion, as the cylinder is steam-jacketed, although there is an expansion joint provided.

If the flanges of the side-pipe ells are not male and female, I believe that the trouble could be stopped by making the bolt holes a little larger and not do the final tightening up until the joint had "found its self." If it is a male and female joint, the tongue will probably have to be relieved a bit.

EDWARD H. LANE.

Kansas City, Mo.

Reduced Angular Advance

Referring to George Dreyer's letter under the above title in the issue of Jan. 23, I would say that it seems quite natural that a reduction of the angular advance would result in smoother running. Before the reduction was made the full pressure of the steam was exerted against the piston before it had reversed the direction of its travel. Consequently, even the slightest lost motion or looseness anywhere was bound to cause a noticeable pound.

When the change had been made the full steam pressure against the piston was not developed until the reverse stroke had been fairly started, as indicated by the slanting admission line. Hence the extreme reaction of the steam pressure and the momentum of the flywheel and moving parts were eliminated.

J. W. DICKSON.

Memphis, Tenn.

Cure for Hot Bearing

Referring to the practice mentioned by F. P. Strachan in the Feb. 13 issue of filing flats on a journal to cure a hot bearing, I have tried it on two very obstinate cases with perfect success.

I was having all kinds of trouble with the outboard bearing of a side-crank engine; the babbitt at some time had been heated and squashed out enough to let the shaft down about ¼ in. When I took the job, the shaft was level, but there was a ¼-in. shim under the bearing, and a quarter-inch space between the journal and the top cap. The journal was 9 in. in diameter and the babbitt metal hugged it closely for 180 deg. of the circle, if not more, and it seemed hopeless to get any lubricant between them. I chipped and filed one flat place

on the shaft, taking care of the chips and filings, to keep them out of the bearing. My idea of the flat was that it would catch some of the oil at each revolution, and carry it down to the place where it was needed.

I have recently tried the same cure in a very similar case, and with the same success, but I do not think much of the idea as applied to new machinery.

B. COPPING.

Oliver Springs, Tenn.

In the issue of Feb. 13, F. P. Strachan gives an unique way of curing a hot bearing and asks why it should not be adopted. If main-shaft journals of large engines were scored in this manner I would consider it poor practice, because the flat places would be hard on the babbitt and it would probably be necessary to rebabbitt the bearing twice as often as if the journal were perfect. The flat places would increase the pressure per square inch on the babbitt touched by the other places on the shaft.

The flat spots on the shaft would also tend to fill the oil with small particles of babbitt which would mean frequently renewing the oil in the oiling system. Taking it all together, I cannot see that flat spots would be of any advantage.

Good oil grooves cut in the babbitt would be a great deal better. A continuous oiling system with the bearings flooded with oil would go a long way toward preventing any hot bearing.

A. RAUCH.

Swissvale, Penn.

A Plant the Central Station Did Not Get

In the Feb. 13 issue it was told editorially how the central station got one plant. The following tells of one plant the central station did not get.

It is one of the large modern office-building installations of about 4000 hp. Hundreds of motors are used throughout the plant, and there are upward of 25 first-class passenger elevators—a veritable eyesore to the central-station solicitors. These people were covetous of this possible plum, and dreamed of one day ousting the old force and equipment and installing central-station service.

The company was going to build, and, of course, more power would be required, and the psychological moment had arrived for the central station to make its supreme effort. Many thousands of dollars worth of business depended upon it.

The chief is an ordinary everyday engineer, just like thousands of others who work in large cities but—he was not, like many, allowing his ego to get the upper hand of his better judgment; he was conscious of his eager competitors, and he knew that some day they would force him to render an account of his stewardship before a disinterested tribunal whose verdict would mean either his downfall or his permanency. And now that day had come.

A thorough, elaborate test of every piece of power-generating and power-consuming apparatus in the plant was begun. Days were spent in preparing for it; many more in conducting it, and finally the test was ended.

In his report to the board of directors the reputable engineer who conducted the test gave the facts as he found them. So favorable were they to the administration of the chief that a representative of the central station who was present was astounded by what he heard and exclaimed: "Why, our plant could not do as well!"

The engineer told him that if it could not, it had better get men that could. They did, but it was then too late to pluck the now harvested plum.

Efficiency accomplished it all. Be efficient and endure.

B. H. CHESTER.

Harrison, N. J.

Comparative Efficiency of Boilers

Supplementing the answer to the question under the above title in the Feb. 13 issue, I wish to point out that the water-tube boiler has these points in its favor.

1. Higher working pressure.
2. Larger capacity in a single unit.
3. Less floor space per horsepower installed.
4. Freer from disastrous explosions.
5. More accessible for cleaning.

To prove that the water-tube boiler is more efficient than the return-tubular boiler by submitting copies of tests would be impossible, for there are very few tests which are reliable. I believe, however, that there are other considerations to be given to this question and if accurate tests could be produced, the higher efficiency of the water-tube type could be shown. All boilers for power-plant use are built of plate and tubes of practically the same thicknesses, and having the same properties of heat conductivity, therefore, based on this consideration only, one boiler would be just as efficient as another.

Units fulfilling the following qualifications are more efficient than other types:

1. Best arrangement of the heating surface.
2. Best arrangement for baffling the gases.
3. Closest confinement of the gases to the heating surface throughout their travel.
4. Definite circulation.
5. Rapid circulation.
6. Best position of each individual section of the heating surface in its relation to contact with the hot gases, the accumulation of soot and scale.
7. Least restricted areas for the circulation of water, steam, or both at any point.
8. Gas passages of either fixed cross-sectional area or uniformly diminishing with the reduction of the volume of the gases due to decrease in temperature.
9. Fewest possible turns in gas passages to prevent increase in drop in draft.
10. Construction of baffles to entirely prevent short-circuiting of the gases.
11. Greatest possible steam area at point of liberation of steam from the heating surface to steam space.
12. Greatest possible practical distance between water level and steam outlet.
13. Steam space surrounded by hot gases.
14. Ample steam storage capacity to prevent any tendency toward lifting of the water by steam leaving the boiler.

A boiler must be kept clean to be efficient; therefore,

15. Fewest necessary parts to be removed to gain complete accessibility to all parts for cleaning.
16. Cost of cleaning as to time, labor, etc., to ward off carelessness and neglect of this operation.

Relation of setting to boiler efficiency:

17. Setting should be air-tight.
18. Setting should have proper thickness of walls with air spaces or material forming dead-air cells to prevent radiation.

The type of boiler having the greatest number of these advantages in its construction is best qualified for making and delivering dry steam; therefore, it should be the most efficient.

B. LEWIS.

New York City.

Lubricator Experience

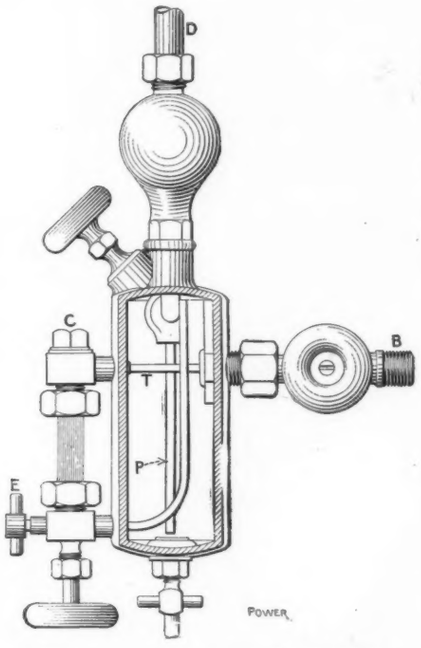
Mr. Watson's lubricator troubles described in the Feb. 6 issue recall some of the difficulties I have had with the different makes of lubricator. It is certain that a lubricator will not work unless the mechanical conditions are right.

Mr. Watson's cut of a lubricator, here reproduced, very fairly represents the average construction, but to force oil out through pipe *B* there must be a greater pressure on the oil in the body of the lubricator than that which is exerted by the steam against the oil at the end of pipe *B* in the steam pipe of the engine or pump. This is brought about by the weight of the oil in the lubricator, the weight of the column of condenser water in pipe *P* and the condenser and pipe *D*.

There is no established length for a condenser pipe for the different sizes of lubricators. It is frequently said that it could be too long or too short, and

some contend the longer the pipe the better the lubricator will feed; still others, that if it is too long there will be great liability of the oil being chilled, causing it to coagulate and thereby stop up the feed glass. If it is too short it will keep the oil too warm, cause it to feed too rapidly and smear up the feed glass.

My conclusions are that when a lubricator does not work there is either something wrong with the way it is connected up; something wrong mechanically or out of balance in some way, or the oil is bad. I have many times had just such troubles as Mr. Watson mentions and I find it is poor policy to be continually blowing out the feed glass by means of drip cock *E*. One will break many glasses, especially if the weather is cold and the lubricator is in an exposed position. If the feed glass continues to clog up, first shut off all valves on the lubricator, remove plug *C*, blow back gently



SHOWING DESIGN OF LUBRICATOR

through valve *B* and thereby clean out pipe *T*. Then put a soft rag or piece of cotton waste on a small stick and thoroughly swab out the feed glass. Next, take a tin of water of about the temperature of the water ordinarily in the feed glass to avoid cracking it and refill it, replace plug *C* and open the other valves; then the lubricator should get busy at once. If it does not, shut off everything again, remove plug *C* and drop in a few grains of salt. Salt water has a greater specific gravity than condensed water and it is therefore easy to see why oil, which is naturally lighter than water, will rise more readily through it.

Try to have the lubricator so piped and located that while working its temperature will never be so high or so low that one cannot bear a hand on the condenser without experiencing an unpleasant sensation. When draining be sure to get the water all out, and when starting, open all valves slowly.

THOMAS M. STERLING.

Middlebranch, Ohio.

I differ with Mr. Watson in his letter under the above heading, in the Feb. 6 number, as to blowing out the sight-feed glass. Many engineers blow out the water with steam and thereby heat the lubricator and cause it to be hard to start. Blowing out the sight-feed glass once in three months is often enough if the oil is kept clean. When I refill a lubricator I close the sight-feed valve and the steam valve and open the drip at the bottom, then take out the filling plug and pour oil in the plug opening. By the time the water is out the lubricator is filled and will start to work at once.

When the oil backs down in the feed glass I carefully regulate the feed and let it work empty in the usual way, for the feed is working the same as before, although the drops cannot be seen.

When the lubricator becomes empty the water works through the sight-feed valve and displaces the oil, and it runs through the tailpiece to the engine. When the oil is displaced by water in the sight-feed glass I close the valve and refill the same as above explained.

CHARLES BRACKEN.

Dunlo, Penn.

Noisy Heater

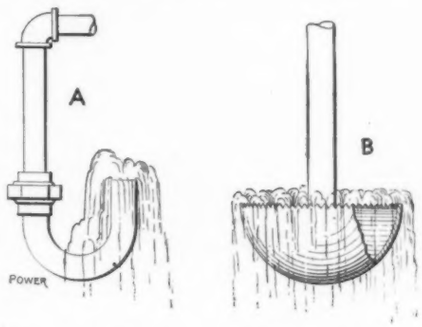
I think that L. C. Greene's trouble with a noisy heater, as related in the Feb. 6 issue, lies in the overflow pan, judging from my experience.

The heater of which I speak was noisy at times, especially when using the most water. Every time the heater was opened I would find that the overflow pan had jumped off of its supports. This pan fitted very close to the top of the heater, thus leaving a very small steam space between the top of the heater and the surface of the water in the pan. This had a tendency to produce water-hammer, causing the pan to lift off of its supports and kick over out of place. All that kept it from falling out was the extension of the water pipe into the pan. The trouble was cured by cutting down the sides of the pan 1½ in.

E. G. HOPPE.

Cairo, Ill.

Referring to L. C. Greene's heater, described in the Feb. 6 issue, I think that the noise is caused by the cold inlet water condensing the vapor in the top of the heater. He does not show by sketch the arrangement of the heater, but I have always found that if cold water is admitted to any steam space by a pipe projecting downward into it, the noise will be caused in the pipe. It may be overcome by sealing the end of the pipe with



SHOWING MANNER OF WATER SEALING PIPE OUTLET

water, as shown at *A* or *B* in the accompanying figure. This is done in many types of heater.

W. T. MEINZER.

Brooklyn, N. Y.

Firebrick Furnace Arches

In Mr. Dixon's article under the above caption, in the Feb. 20 issue, a table was inadvertently given, the figures of which corresponded with the rise per foot of radius. Although this might be used in some cases, it is not nearly as useful as the accompanying table which is the one that should have been included in the article.—EDITOR.

Inches Rise per Foot of Span	Arc	Inches Rise per Foot of Span	Arc
1/8	23° 45′	1 3/8	67° 15′
1/4	26° 10′	1 1/2	69° 30′
3/8	28° 30′	1 5/8	71° 40′
1/2	30° 50′	1 3/4	73° 45′
5/8	33° 05′	1 7/8	75° 50′
3/4	35° 30′	2	78° 00′
1	37° 50′	2 1/8	80° 10′
1 1/8	40° 10′	2 1/4	82° 15′
1 1/4	42° 25′	2 3/8	84° 20′
1 3/8	44° 45′	2 1/2	86° 25′
1 1/2	47° 5′	2 5/8	88° 10′
1 5/8	49° 20′	2 3/4	90° 30′
1 3/4	51° 40′	2 7/8	92° 30′
1 7/8	53° 55′	2 7/8	94° 15′
1 3/4	56° 10′	2 1/2	96° 30′
1 7/8	58° 25′	2 3/4	98° 30′
1 7/8	60° 45′	2 1/2	100° 30′
1 1/2	62° 50′	2 3/8	102° 30′
1 3/4	65° 05′	2 1/8	104° 20′

License Laws

Referring to the recent discussion under the above heading, Mr. Hawkins need not go to Massachusetts to find the kind of examination he desires; Baltimore is nearer for him.

Here we have examinations which embrace such matters as valve setting on slide-valve, automatic and Corliss engines, principles of operation of various types of governor, indicator diagrams, bracing boilers, safety-valve rules, safe working pressures, horsepower of engines and boilers, boiler efficiency, safe speeds of flywheels, refrigeration, hydraulic elevators, installation and care of piping, etc.

M. N. STEVENS.

Baltimore, Md.

Death of Rear Admiral Melville

Rear Admiral George Wallace Melville, U. S. N., retired, noted as an engineer and explorer, died at his home in Philadelphia on Mar. 17 from paralysis.

Born in New York, Jan. 10, 1841, he was descended from a distinguished Scotch family which figured prominently during the reign of Henry VIII. He was educated at the Brooklyn Polytechnic Institute and later entered as an apprentice in the engineering works of James Binns, in Brooklyn, where he received his practical training.

At the outbreak of the Civil War, he entered the navy as third-assistant engineer and served on board the "Michigan," the "Dakota" and other vessels, and took part in several engagements, including the capture of Norfolk. Shortly after this, however, he contracted typhoid fever and was sent to the hospital at Key West.

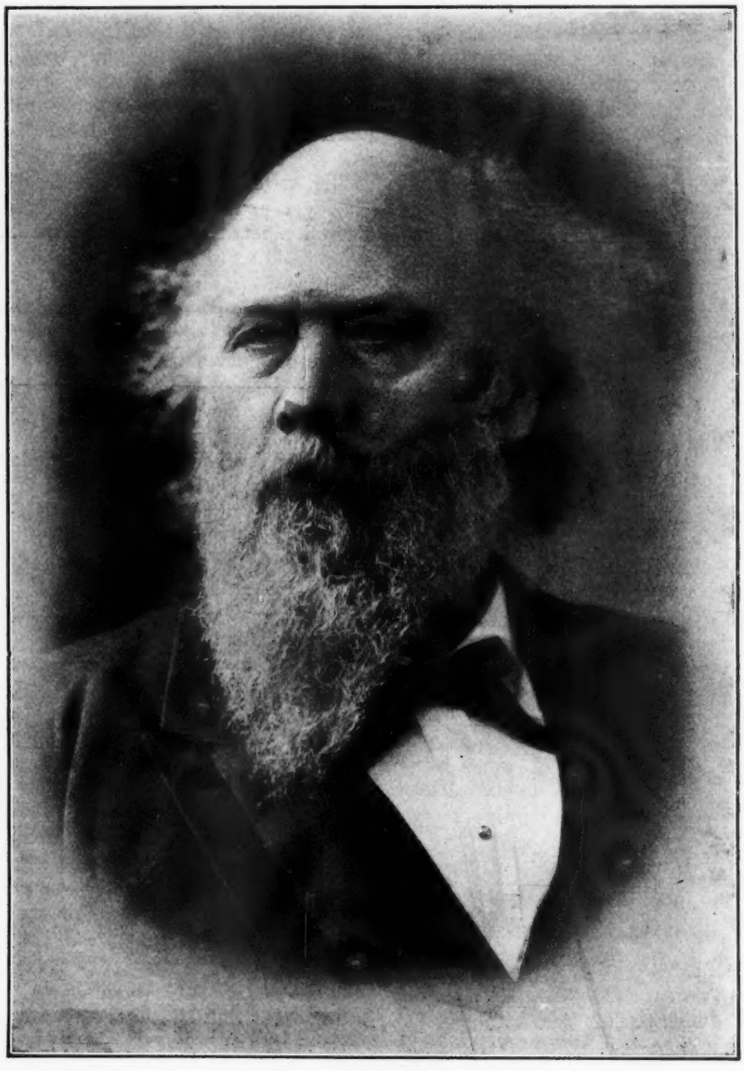
In 1864, the "Wachusett," to which he was attached, was lying in the port of Bahia, Brazil, near the Confederate ship "Florida" and at a council held in the cabin it was proposed to ram the latter vessel, but an objection was raised on the ground that the shock would loosen the boilers, break the steam-pipe joints and scald everybody below on the "Wachusett." Melville met this objection by the quiet proposition to stay below alone and take his chances, and the scheme was adopted. In the attack, a cable jammed and an ineffective blow was struck, but the "Florida" was otherwise captured and Melville was put on board of her to act as chief engineer.

After a period of several years spent on various ships of the navy, Melville became associated with a series of arctic relief expeditions which were destined to make him an international figure.

The "Jeanette" expedition through Bering Straits was equipped for the government in 1879 with funds supplied chiefly by James Gordon Bennett, of the *New York Herald*. Lieutenant De Long was selected to command the expedition and Melville was chosen as chief engineer. From the start at San Francisco, Melville seems to have been the main reliance of De Long, whose reports redound with his praise, and are so much occupied with his mechanical contrivances that, as the commander himself remarked, "they look more like an engineer's notebook than a seaman's log."

The necessity for constant pumping to keep down a bad leak encountered in the ice pack led Melville to contrive all sorts of devices for saving coal, culminating in a pump and windmill of his own manufacture. His courage and cheerfulness never faltered, and he kept up the spirits of the others.

Soon after passing through Bering Straits, the "Jeanette" was caught in the ice pack, where she was held for nearly two years, drifting 500 miles to the northwest. On June 11, 1881, the "Jeanette" sank, her crew being forced to escape on foot over the ice toward the Siberian coast, a distance of 500 miles, the nearest intervening island being 150 miles away.



REAR-ADMIRAL GEORGE WALLACE MELVILLE, U. S. N., RETIRED

After two weeks, De Long observed that the drifting of the fields had carried them 21 miles farther north than at the start, but by August they arrived within 90 miles of the mainland, a journey across open water being possible the rest of the way. De Long had distributed the party in three boats, taking charge of the first one himself and placing the others under command of Lieut. Chipp and Melville respectively.

A storm arose and Chipp's boat foundered, De Long's and Melville's being separated. The latter reached land and after excessive hardships found a settlement of the Yakut Eskimos from whom he received succor. The party had frozen hands and feet, Melville himself for 15 days being unable to stand. As soon as possible, he proceeded south to a Russian outpost, but instead of returning to civilization, he immediately collected such supplies as northern Siberia afforded and turned back into the winter night to search for De Long's party, two scouts from which had met him. His only companions were two Yakuts. The windings of the retreat from the "Jeanette" had aggregated 2200 miles; now, with hardly any intervening rest, Melville's devotion to duty led him 1100 miles more and this under conditions of season and preparation which rendered his exploits practically unprecedented. He found traces of De Long, but lost the trail and thus was compelled to return.

Even this was not the end of his efforts, for January found him northward bound again, with better equipment. At last he discovered the corpses of De Long and others and buried them on a high point of land, building over their graves a cairn with a timber cross, which tomb has been reproduced in granite and marble at Annapolis, where the bodies now repose.

But still another Arctic voyage lay before Melville. Lieut. A. W. Greely, U. S. A., with a party of 25, had been sent in 1881 to establish a meteorological station at Lady Franklin Bay in the Greenland region. Being cut off from supplies and not having been heard from, a relief expedition was sent to their aid in the winter of 1883-84.

In the equipment of this expedition, much dependence was placed upon Melville's advice. He went along as chief engineer of the "Thetis," flagship of Commander (later Rear Admiral) W. S. Schley, who subsequently came into fame at the battle of Santiago. The starving survivors of the Greely party were finally found near Cape Sabine, in Ellesmere Land. For his gallant work in connection with this expedition he was awarded a gold medal by Congress and was advanced 15 numbers in rank, soon being detailed as chief engineer of the navy.

Admiral Melville did not tarry about making much innovations in naval design as his good judgment dictated. One of the first was to get rid of the notion that engines must be horizontal, so that they could be stowed down in the hold where nobody wanted to put anything else. His initial venture with vertical engines was upon the "Maine."

About the beginning of Melville's term, the recent resumption of the use of forced draft had brought about a craze all over the world for reducing boiler weight to the last degree, and the talented Sennett, the British engineer-in-chief, ruined his reputation by the effort to get a horsepower on less than 1.5 sq.ft. of heating surface. At first there was nothing but praise for him, but when one ship after another proved a failure, it was found that he had been reckless. Melville refused absolutely to go to such lengths, his favorite expression being, "I never send a boy to do a man's work." While the English ships were being pulled through at reduced power by the Admiralty ferrule, the United States ships went along without a single failure or mishap and the rest of the world found that Melville, while as bold as the boldest, would not sacrifice sound engineering to popular clamor. He was conservative in his progressiveness.

He was the first engineer-in-chief of any navy to come out distinctly and strongly as an advocate of water-tube boilers for large vessels and, moreover, was the first naval engineer to secure accurate data upon the coal consumption in forced-draft trials. He also introduced the standardized screw as a method of determining speed trials, and credit is due to him for the first series of experimental data on the use of steam jets for forced draft.

One of Melville's greatest successes early in the building of the new navy was the 20,000-hp. cruiser "Columbia," built in 1890. In her construction, Admiral Melville, against the urgent advice of friends, risked his professional reputation to provide triple screws. When designed, this ship had larger machinery than that of any afloat. She crossed the ocean from Southampton to Sandy Hook in less than seven days, greatly reducing the existing warship records for a transatlantic passage and beating, by at least a day, the expectations of her designer and builder. Even this speed record was soon broken by her sister ship the "Minneapolis."

Foreign nations, England not included, followed the lead and made extensive use of triple screws, but for some reason which has never been explained, the admiral's desire to continue the policy of putting them in was negatived by the Navy Department.

How far Melville was ahead of the general naval mind, can be inferred from his suggestion of a ship of the "Dreadnought" type as long ago as 1899. Furthermore, his resourcefulness was exhibited during the war with Spain in the construction of a repair ship and a water-distilling ship.

One of the remarkable characteristics of Admiral Melville, which enabled him to perform such an immense amount of work, was his quality of inspiring admiration, respect and loyalty in his subordinates.

Under the rule of retirement at 62 years of age, he passed out of office in August, 1903, at the end of his third term and sixteenth year as engineer-in-chief of the navy. So long a tenure of office by a bureau chief was probably unprecedented in the navy. He was then as active, mentally and physically, as most men are at fifty.

Admiral Melville later resided in Philadelphia, which had been his home before his service in Washington, and was the recipient of distinguished professional honor. In 1896 he received from Stevens Institute of Technology the degree of doctor of engineering, an honor which is rarely granted by that institution. Among other degrees awarded him was LL.D. His bust in bronze adorns the War Museum of the Loyal Legion in Philadelphia.

As president of the American Society of Mechanical Engineers, he had already served the term of 1898-1899, and when the society met in Washington in May, 1909, a session was spent in witnessing the presentation of his portrait, painted by Ivanowski, to the National Gallery.

Convention, American Boiler Manufacturers' Association

The twenty-fourth annual convention of the above association was called to order on Tuesday forenoon, Mar. 12, at the St. Charles Hotel, New Orleans, by the secretary, J. D. Farasey, and was welcomed to the city by Mayor Behrman. In the absence of the president, Col. E. D. Meier, W. H. Bateman responded in behalf of the association. J. Don Smith, of Charleston, second vice-president, then introduced John A. Murphy, of New Orleans, who, as a local member of the association, seconded the welcome of the mayor. While he was speaking, President Meier, whose train had been delayed, came in, and received a rousing welcome. J. W. Porch, president of the Progressive Union, was introduced and told of the work of the city in conserving to the people the river front, the building of a municipal belt line, water-works sewage plant, etc.

During the afternoon session D. J. Champion, of Cleveland, presented a paper upon "Rivets." Twenty years ago steel was regarded as a hard brittle metal adapted for the making of razors, etc. The openhearth basic process had made possible the production of steel which was better than iron for most of the uses for which that metal had been employed. In addition to high tensile strength it possessed great ductility, but it is not fibrous as is iron, and should not be subjected in the form of rivets to the nicking and bending test.

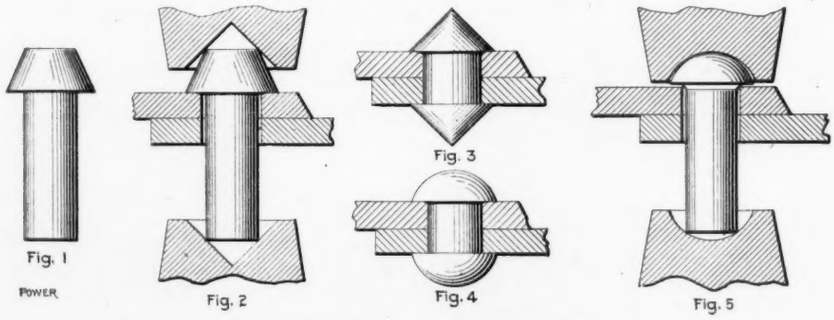
Mr. Champion's paper brought out an unlisted paper or discussion by H. J. Hartley, of the Cramp Ship Building Co., of Philadelphia, on "Hydraulic Riveting." His remarks dealt with the subject of hydraulic pressures as applied to riveting, on which there appears to be considerable diversity of opinion. In a number of tests made by William Sellers & Co. the data pointed to a pressure of 300,000 lb. per square inch of rivet section for driving and heading cold rivets. At the Baldwin Locomotive Works a series of tests for determining the best pressures for driving rivets in high-pressure steam boilers gave an average result of 160,000 lb. per square inch of rivet section. Mr. Hartley emphasized the importance of the increased pressure at the terminal stroke of the ram due to the surge of the accumulator at the end of the stroke. The increase runs as high as 60 per cent. and its effect in filling the rivet hole and making tight work is much the same as a second pressure of the rivet after it is partially cooled. In the course of his talk the speaker displayed a number of blueprints showing the shapes of rivet heads in common use. These are reproduced in the accompanying illustrations.

Fig. 1 shows the shape of rivet head mostly used by manufacturers. Fig. 2

shows a rivet with a pan-shaped head, ready to be driven with cone-shaped dies; the rivet being hot and the initial pressure bearing on the head and point, it necessarily follows that the rivet must flow into the dies before it gets bearing sufficient to squeeze it into the dies.

Fig. 3 represents the shape of the rivet head after being driven.

Fig. 5 shows a rivet with a round-shaped head, with a fillet under the head, heated and ready to be driven. It may be noticed that the dies on the head and point bear more centrally, and while the



die at the blank end of the rivet has a slight point bearing like Fig. 2, yet it is so little, due to the head end being solidly and firmly held in the die, that it may be said the initial pressure is bearing centrally on both ends of the rivet, thus permitting the rivet to flow into the hole while filling the radial-shaped dies. In other words, the main feature is accomplished by the rivet filling the hole before the head is formed.

Fig. 4 is a sketch of a rivet driven with a round-shaped die.

The round head is the better and also stronger in the shearing section of the head. It is also much easier to calk a round-head than a cone-head rivet, if such should ever be required. The first indentation of the calking tool on a round-head rivet forms an arch or backing to the tool, which has the effect of forcing the metal down to the plate, similar to calking the edge of a seam, while the same operation on a pan- and cone-shaped head has a tendency to curl up the thin edges of the rivet on account of insufficient metal above the calking surface.

On Wednesday morning the first order of business was to report Cleveland as the convention city for 1913, when the silver anniversary of the association will be celebrated. All the officers of the previous year were reëlected, as were also those of the supplymen with the exception of T. P. Wallace, of the executive committee, who is now replacing W. L. Hirsch, of Pittsburg. The convention was then ready for the papers scheduled for the day.

In the absence of H. A. Beale, Jr., George Thomas, of the Parkesburg Iron Co., presented a paper on the "History of Charcoal Iron and the Manufacture of Charcoal Iron Boiler Tubes." He took up the earlier methods of production direct from the ore and then dwelt at some length upon the present practice in this country of making charcoal iron from wrought and steel scrap. In this process the forge fire is run with a cold blast and one tuyere is used, the cold blast producing a better quality of iron and the one tuyere making it possible for the forgeman to give closer attention to the mixture.

He stated that the principal use of charcoal iron in America is for iron roofing and boiler tubes, the advantages possessed for the latter service being that it will not crystallize under shock, that it is ductile, is noncorrosive and will not pit. In explanation of its noncorrosive qualities two theories were advanced: one, that the intimately mixed network of cinder forms a protective covering; and another, that its homogeneous nature, purity and low percentage of manganese prevent electrolysis.

The paper of J. J. Dunn, of the Shelby Steel Tube Co., dealt with the manufacture of seamless steel boiler tubes and proved especially instructive. Mr. Dunn showed how the development in steam engineering had progressed hand in hand with the processes in manufacturing steel, dependent, of course, upon the ability of the material to withstand the steam pressures used. He then described and illustrated the method of manufacturing seamless steel tubing by the piercing and cold-drawn processes and gave comparative figures relating to the strength and ductility of hot- and cold-drawn tubing.

The use of compressed air in boiler shops was taken up somewhat in detail by Thomas Aldcorn, of New York. Basing his argument upon the contention that the generating plant, of which the compressor is an important element, is really the heart of the whole establishment, Mr. Aldcorn proceeded to give some pointers on compressors. In this connection he recommended the pressures to be employed and under what conditions single and compound compressors should be used. Regarding the use of pneumatically operated tools he showed how not only was the speed increased but also that the quality of work was improved with air-driven riveting machines, hammers, drills, etc., as compared to similar tools when operated by hand.

H. C. Meinholtz, of St. Louis, Mo., gave an instructive paper upon the modern boiler shop, taking up the location, construction, general arrangement and equipment.

"Boiler Explosions, Their Causes and Prevention" was the subject of a paper by S. F. Jeter, of the Hartford Steam Boiler Insurance Inspection Co. An abstract is presented on pages 426 and 427 of this issue.

A Group at the New Orleans Convention

Charles L. Huston, vice-president of the Lukens Iron & Steel Co., discussed the segregation of carbon, phosphorus and sulphur during the process of cooling, thus producing steel of nonuniform quality and making a higher factor of safety necessary. This segregation, he attributed to two causes: first, the steadily accumulating wall of solidified steel at the outer portion near the mold con-

stantly expels into the liquid portion the hardening elements or metalloids, such as carbide of iron, etc.; second, there is a tendency for these metalloids to float toward the top by reason of the difference in specific gravity.

Closely related to this segregation is the formation of blow-holes due to the confined gases within the ingot. Experiments were quoted to show that if the metal is rolled hot, these holes will close up to a large extent, so as to produce a fairly solid plate, although their entire elimination is almost impossible.

Mr. Huston recommended a good soft steel of moderate tensile strength (about 55,000 lb. per square inch) rather than a steel of high tensile strength which is apt to be brittle. This point had recently been impressed upon the United States government officials and as a result they have consented to a reduction in the specifications from 75,000 to 65,000 lb. per square inch.

W. H. S. Bateman gave an interesting talk on the association in the old days, as it is at the present, and concluded with some suggestions for its betterment. It was his opinion that the society should be divided into five sections as follows: Marine boiler; water-tube boiler; return-tubular boiler, including small type fire-box boilers; house heating, miscellaneous boilers and pressure tank builder's section, and locomotive boiler. Each section to have its own chairman and secretary and the larger sections, if necessary, to be subdivided and located in the various states, according to the number of shops within a certain territory. At the convention these sections could hold their own meetings and all could be arranged so as not to interfere with the general meeting of the association as a whole. The appointment of a committee to confer with the various state legislatures who are contemplating the introduction of state boiler rules and regulations was also recommended.

On Thursday the report of the Committee on Uniform Boiler Specifications was read and unanimously adopted. It called for several modifications in the Massachusetts laws, and as it was the most important feature of the entire convention, it will be printed in full in the next issue of POWER.

W. O. Hart, member from Louisiana of the National Commission for Uniform State Laws, appeared before the convention and told of the work of this commission, which includes accredited representatives from every state and territory except Alaska. They will meet at Milwaukee probably in August and would be glad to consider uniform boiler laws. His invitation to have a representative of the association present at the meeting was accepted.

The convention adjourned at noon on Thursday to assemble the same evening at the banquet at the St. Charles. About 125 sat at table, with Col. E. D. Meier officiating as toastmaster. An especially appreciated feature was the presentation on behalf of the supplymen's association by Thomas Aldcorn of a silver set of five pieces, to John Corbett, president of the Supplymen. All ladies were presented with a silver souvenir spoon of New Orleans make and emblematic of the city. The usual resolutions of thanks to the mayor, local committee and all who had contributed to the success of the meeting were passed, and the 1912 convention adjourned with a high appreciation of the hospitality and courtesy extended and the elaborate arrangements made for the entertainment of the ladies.

BOILER MANUFACTURERS' BANQUET AT THE ST. CHARLES HOTEL, NEW ORLEANS, LA.

First Steam Turbine Now a Monument

The General Electric Co. has reërected in the center of a park plot in its grounds at Schenectady, N. Y., the first 5000-kw. Curtis steam turbine installed in the Fisk St. station of the Commonwealth Edison Co. at Chicago. It is to serve as a memorial to the rapid development of the steam-turbine unit applied to central-station service.

This turbine was installed in the Fisk St. station eight years ago, being put in operation Oct. 2, 1903, and remained in continuous service until May 29, 1909. It was specified in the contract by President Insull when this unit was replaced that it should be set up as a monument to commemorate the great step in engineering which its installation marked. A bronze tablet detailing its history has been placed on the turbine.

Boiler Explosion at Fluvanna

By the bursting of a boiler in the Smiley crating mill, on Mar. 11, at Fluvanna, Penn., the plant was completely wrecked and two men injured. It is thought that a frozen pipe indirectly caused the accident.

Locomotive Boiler Explosion

By the explosion of a Southern Pacific locomotive in this road's roundhouse at San Antonio, Tex., on Mar. 18, it is reported by the daily press, 32 strike breakers were killed and 60 were badly injured. No further details could be had at the time of going to press. There is a strong rumor that the explosion was caused by a charge of nitroglycerin.

Newark Industrial Exposition

Elaborate preparations are being made for the industrial exposition to be held in Newark, N. J., May 13 to 25.

It is claimed that 100,000 different articles are manufactured in the 3000 shops of the Newark industrial district. Not only will the products of Newark's factories be shown, but also the processes of manufacture. There will be many special features of an entertaining and educational nature, including a series of lectures on the industrial development and opportunities of Greater Newark.

The committees in charge number 300 representative citizens of the Newark industrial district, including Chairman Curtis R. Burnett, president of the Board of Trade; Thomas A. Edison, ex-Governor Franklin Murphy, Forrest F. Dryden, president of the Prudential Insurance Co.; Frederick Frelinghuysen, president of the Mutual Benefit Life Insurance Co.; Hon. Thomas N. McCarter, president of the Public Service Corporation of Newark.

No Water Power Trust on Government Territory

On Mar. 13, at Washington, the House, by a vote of 98 to 37, defeated a measure permitting the Hydro-Electric Co. to lay a pipe line across part of the Mono National Forest Reservation in California.

It was charged that the "water-power trust" had sought to influence the legislators and several members claimed that they had been victims of a lobby.

Representative C. D. Smith, of New York, has introduced a bill to compel every "counsel or agent" of corporations or individuals seeking Congress legislation to register with both houses on Dec. 1 of each year, with heavy fine and imprisonment as penalty for failure to comply. His bill would compel corporations and others who employ lobbyists to file with the Senate and House two months after the close of each session of Congress a detailed statement of expenses.

CORRECTION: In the tabulation of power-plant equipment of the Hazard Manufacturing Co.'s new power plant, published in the Mar. 12 issue, the pumps were said to be manufactured by the Nelson-Snyder Manufacturing Co.; the firm name is, of course, Wilson-Snyder.

A Million Dollar Plant for Savannah

A power plant of 11,000 kw. capacity and costing $1,000,000 will be built on the Savannah River by the Savannah Electric Co.

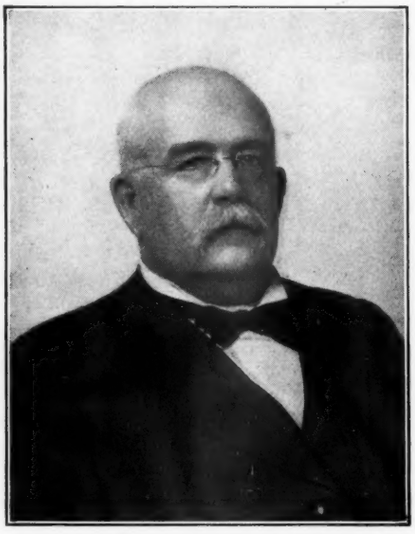
Work will begin at once and it is stated that the plant will be completed by Nov. 1. The company has been given options on three plots of river property, but it has not been determined which will be purchased.

Coal Mined in 1910

The amount of coal mined in the United States in 1910, according to figures of the United States Geological Survey, was greater by 10,000,000 tons than the total tonnage which had been mined up to the close of the year 1871.

OBITUARY

Dr. Henry Wilson Spangler, Whitney Professor of Dynamical Engineering at the University of Pennsylvania, Philadelphia, Penn., died on Mar. 17, at his home in West Philadelphia.



PROF. HENRY W. SPANGLER

Dr. Spangler, who had been connected with the University of Pennsylvania for more than 20 years, was born in Carlisle, Penn., on Jan. 18, 1858. He was graduated from the United States Naval Academy in 1878 and was an engineer in the United States Navy from 1878 to 1889; and in 1898, during the Spanish-American War, he again served in the Navy for a short time.

He was called to the university in 1881 to take the chair of Assistant Professor of Mechanical Engineering, which position he held for three years and again for two years, from 1887 to 1889, when he became professor. Dr. Spangler was the head of the mechanical engineering department until his death and held the Whitney Professorship of Dynamical Engineering.

In 1896 the university conferred upon him the honorary degree of Master of Science and ten years later the degree of Doctor of Science.

He was a member of the Advisory Council of the Engineering Congress held in Chicago in 1893; a member of the Jury of Awards of the Buffalo Exposition in 1901, and a member of many scientific organizations, including the Franklin Institute, American Society of Mechanical Engineers, American Society of Naval Architects and Marine Engineers and the Engineers Club of Philadelphia, of which he was president in 1890 and again in 1908.

Doctor Spangler was the author of a number of standard works, among them one on "Valve Gears," "Notes on Thermodynamics," "Elements of Steam Engineering," and was the co-author of "Graphics."

SOCIETY NOTES

A lecture on "Steam Plant Management and Operation" will be given under the auspices of the general committee of the Combined Associations, N. A. S. E., of Manhattan and Bronx, by Prof. E. V. Lallier, M. E., at the Broadway Central Hotel, Broadway near Third St., on Wednesday evening, Apr. 3, at 8:15 p.m. This lecture will combine the four essential features of steam-plant operation, practical training, technical knowledge, coöperation and the physical condition of the plant. Members of all bodies of operating and mechanical engineers, owners of steam plants, real-estate agents and steam users are cordially invited to attend.

PERSONAL

H. R. Setz, chief engineer of the Struthers-Wells Co., of Warren, Penn., for the last two years, has just accepted the position of chief engineer with the Otto Gas Engine Works, of Philadelphia. Mr. Setz was formerly connected with several of the leading American and European gas- and oil-engine manufacturers. His particular attention will be directed toward the development of a complete line of horizontal Otto Diesel engines.

Albert E. Guy, for six years chief engineer of the De Laval Steam Turbine Co., Trenton, N. J., now occupies a similar position with the Wilson-Snyder Centrifugal Pump Co., of Pittsburg, Penn. This company, in connection with the Wilson-Snyder Manufacturing Co., has been organized to manufacture and sell complete new lines of high-grade centrifugal pumps of Mr. Guy's design. As many of our readers will remember, Mr. Guy has been a prominent contributor to POWER of technical articles.

Moments with the Ad. Editor

The advertisements in the issue of February 6 attracted wide attention from readers and we publish here two letters received in reference to them.

The first comes from Champaign, Illinois, and jumps into the subject without preliminaries.

1. The ad. of the Pennsylvania Coal and Coke Company seems to have the faculty of attracting and holding one's attention. There is a note of sincerity and of personal interest in the consumer about it which is effective. It also sticks to the modern idea that customers are not criminals, to be mistrusted and abused, but are men, who must be systematically instructed in the merits of any product.

The talk is practical and forceful, with a suggestion that more of the same kind are to follow. It offers something in the shape of the booklet, "The Engineers' Problem in Selecting Coal." The interest of the reader is held throughout.

2. The American Steam Gauge and Valve Manufacturing Company's ad. is effective and valuable by striking at the keynote of engineering activity—efficiency. The ad. occupies a prominent position, there is no tediously fine print, and the absence of long words is noticeable. The extreme simplicity, yet great importance of their product, is shown, as well as an indication of their prices. The ad. is not perfect, grammatically, but by this lack of perfect grammar and the use of short sentences with catchy beginnings, the reader is led on throughout the ad., and becomes thoroughly interested in the products.

3. I believe the Stephenson Manufacturing Company's ad. the best in every particular in that it condenses a large amount of important knowledge in a small space. It compares their product with others and ends up with the ever-tempting offer of something for nothing in the shape of a free sample of their product. The cuts are clear and full of meaning, the wording of the sentences is simple, and no long drawn out sentences and cumbersome words mar the real enjoyment of reading the ad. through. Altogether, the ad. combines what I consider the prime necessities for a good ad.: 1. Attractiveness. 2. Simplicity. 3. Real knowledge. 4. Unity.

5. I answered the ad. of the American Steam Gauge and Valve Manufacturing Company.

Best wishes for the future of POWER, as well as thanks for the good it has done me in the past.

The next letter is from Scranton, Pennsylvania, and, while it does not answer all of the questions, it does give an analysis of one ad. that is well worth printing.

With regard to what may be considered the best all round ad., in looking through the selling section the one that particularly attracted my attention is on pages 84 and 85, "How to *Sell* the Taylor Stoker." In my opinion it is *the best* in that particular issue, for the following reasons:

It occupies *two whole pages* and, using one of your own phrases, "it pulls the eye" to it immediately. You can't help reading such an ad. even if you do not want a stoker right away. I firmly believe that the busy men read the two-page and one-page ads. *first* and the others afterward *if there is any time left to do it in*, simply because the former are easier to read in every respect.

The neat point is the paragraphic division which tells the story in an interesting manner and actually *drags you along with it* until you have read the very last line.

The unique manner in which the story is introduced also rivets one's attention at *the very beginning*, and the typographical effect throughout *holds* the attention.

Last, but not least, the *substance* of the story—the telling of the modus operandi—the convincing commercial engineering points touched upon, appeal to the reader and set him thinking about costs and things in his own plant. It is a straightforward ad. that will instill confidence in the minds of readers that it cannot do other than make good, simply because they would not place a sale in a plant in which no further improvement could be made.

Had the —— —— —— ad. contained *a concrete example* of a saving resulting from the installation of one of their product, it would carry more weight. Aside from that it is a good half-page ad., full of interest, and while it does not leave the reader *dissatisfied*, it does leave him *unsatisfied* in the feature I have referred to.

It should be a source of satisfaction to the writer of the Taylor Stoker ad. to know that it was taken exactly as he intended.

It is a new departure in advertising to tell how to *sell* the goods—and it is a good one. To sell a thing one must have his system chockful of its merits. After all, those are what the advertiser wants to get into the minds of his possible customers.

It is worth noting that the ad. which did not give a concrete example of saving did not entirely *satisfy* the reader. Concrete examples are the most convincing things on the footstool. Get 'em into ads. whenever possible.

BUSINESS ITEMS

The main offices of the Osborn Engineering Co., Cleveland, Ohio, will be located at 740 Engineers Building, after Apr. 1.

The Geo. M. Newhall Engineering Co., 1419 Chestnut St., Philadelphia, has taken over and will hereafter supply the Baum Separator for all purposes.

The Lytton Manufacturing Corporation, 1159 Hudson Terminal Building, New York, has appointed Glenn & Stitteler, 227 North Thirteenth St., Philadelphia, Penn., as agents in the Philadelphia district.

Henry R. Worthington, 115 Broadway, New York City, has just issued bulletin W188, giving an extended description of the Worthington horizontal, triplex-expansion, high-duty pumping engine installed in the Hope station of the Providence, R. I., water-works. Copies are sent on request.

Walter B. Snow, publicity engineer, 170 Summer St., Boston, Mass., has increased his organization by the addition of Charles L. Mulligan, late of the editorial staff of the Brooklyn "Standard Union," and for a considerable period associated with the publicity department of the Western Electric Co.

Cling-Surface Co., Buffalo, N. Y., has issued Bulletin No. 321, a neat folder showing eleven noteworthy installations in Pennsylvania where Cling-Surface is profitably used on belts. Each illustration is accompanied by data concerning the belts shown. A copy is sent on request to anyone interested.

The Crescent Belt Fastener Co., Fourth Ave. Building, New York City, has just issued an interesting leaflet "The Broken Belt," containing a little story of an engineer and his broken-belt problem. Every engineer interested in good belt results can secure a copy by writing to the Crescent Belt Fastener Co.

The Power Plant Machinery Co. has opened a Cleveland office in the Rockefeller Building to represent the following manufacturers in the northern part of Ohio: Erie Engine Works, Erie, Penn.; Union Iron Works, Erie, Penn.; McKenzie Furnace Co., Chicago Ridge, Ill.; Safety Equipment Manufacturing Co., Chicago, Ill.

Due to increase of business, subsequent to placing on the market its "Hypress" positive pressure blower and "Watch Dog" feed-water regulator, the L. J. Wing Manufacturing Co. has been compelled to move into larger quarters. It has consequently combined its factory with its offices and is now located at 352-362 West Thirteenth St., New York.

An attractive 16-page condensed catalog describing its various lines of condensing apparatus has just been issued by the Wheeler Condenser & Engineering Co., of Carteret, N. J. It goes into details about the Wheeler Admiralty surface condenser, Wheeler-Volz combined condenser and feed-water heater, the Wheeler Admiralty surface condenser cylindrical shell type, and other Wheeler products. Copies are mailed on request to the company.

At the recent annual meeting of the American Steam Gauge & Valve Manufacturing Co., 208 Camden St., Boston, Mass., the usual annual dividend of 7% on both preferred and common stock was declared. It is also pleasing to note that while the business of this company showed the usual normal increase, 1912 business so far shows an increase of 50% over last year. An increased capacity has become necessary in every department, particularly the gage department, which will shortly be turning out one thousand "American Quality" gages per day.

Rapidly increasing business with C. H. Wheeler high-vacuum turbine condensers makes it necessary for the C. H. Wheeler Manufacturing Co., Lehigh Ave. and Eighteenth St., Philadelphia, Penn., to build a new machine shop. The company has purchased a lot, 400x150 ft., adjoining its Sedgley Ave. property for this purpose and expects to have the new shop, which will increase its output 50 per cent., completed by September. The new equipment will include 30- and 10-ton overhead cranes, together with electric hoists and the very latest electric driven machine tools.

William S. Pitts Co., of 32 Park Place, New York, representing the Scully Steel & Iron Co., Chicago, Ill.; Ohio Brass Co., Mansfield, Ohio (steam specialty department); Northern Specialty Co., Utica, N. Y.; Automatic Steam Trap & Specialty Co., Cleveland, Ohio; McCord Manufacturing Co., Detroit, Mich.; and Willard A. Kitts, Jr., of 143 Liberty St., New York, representing the Kitts Manufacturing Co., Oswego, N. Y.; Howard Thermostat Co., Oswego, N. Y.; Rochester Vacuum Valve Co., Rochester, N. Y., have consolidated and incorporated under the name of the Pitts & Kitts Manufacturing & Supply Co., and are now located at 39-41 Cortlandt St., New York. They have also taken the agency for Perolin German boiler compound.

NEW CATALOGS

Homestead Valve Manufacturing Co., Homestead, Penn. Catalog. Valves. Illustrated, 40 pages, 6x9 in.

Walter O. Amsler, D. Sc., Pittsburg, Penn. Pamphlet. Amsler gas producer. Illustrated, 36 pages, 6x9 in.

The Emerson Electric Mfg. Co., St. Louis, Mo. Catalog No. 6000. Electric fans. Illustrated, 64 pages, 7x10 in.

Wheeler Condenser & Engineering Co., Carteret, N. J. Booklet. Steam Tables for Condenser Work. 32 pages, 4x7 in.

Alberger Pump Co., 140 Cedar St., New York. Catalog D. Centrifugal pumps, steam turbines. Illustrated, 72 pages, 6x9 in.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1142. Electric fans. Illustrated, 30 pages, 8x 10½ in.

Lea Equipment Co., Wayne Junction, Philadelphia, Penn. Bulletin K. High duty turbine pumps. Illustrated, 16 pages, 6x9 in.

Sprague Electric Works, 527 West Thirty-fourth St., New York. Catalog No. 325. Electric fans. Illustrated, 40 pages, 8x10½ in.

The Goulds Manufacturing Co., Seneca Falls, N. Y. Pamphlet. "How and Where Pumping Costs Can Be Reduced." Illustrated, 16 pages, 7x8 in.

Barco Brass & Joint Co., 230 North Jefferson St., Chicago, Ill. Catalog. Flexible joints, exhaust chime outfits, draft opener. Illustrated, 20 pages, 5½x 8 in.

Watson & McDaniel Co., 146 North Seventh St., Philadelphia, Penn. Catalog No. 21. Steam traps, reducing valves, steam pump governors, steam separators, etc. Illustrated, 56 pages, 3½x6 in.

General Electric Co., Schenectady, N. Y. Bulletin No. 4918. Direct-current switchboards. Illustrated, 14 pages, 8x 10½ in. Bulletin No. 4919. Small plant direct-current switchboards. Illustrated, 4 pages, 8x10½ in. Bulletin No. 4924. Thomson prepayment watthour meters for direct and alternating current. Illustrated, 6 pages, 8x10½ in. Bulletin No. 4887. Small turbo-generator sets. Illustrated, 16 pages, 8x10½ in. Bulletin No. 4900. Series incandescent street-lighting apparatus. Illustrated, 34 pages, 8x10½ in.

ENGINEERS WANTED

Under this head are published, without charge, advertisements of actual vacancies in power plants for operating engineers and assistant engineers. For the guidance of applicants for advertised positions, the advertisements must contain particulars to show the class of service demanded and the wages paid. Employers who desire to advertise under this head are requested to write for a blank form of application.

CONSTRUCTION SUPERINTENDENT for a 3000-kw. turbine station, in Rocky Mountain section; equipment to consist of Westinghouse turbines, Wickes boilers, Murphy stokers, etc.; must be thoroughly competent and trustworthy man. Salary, $175 per month. Box 616, Power.

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

SALESMAN — Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," Power.

AGENTS for first-class steam specialty in use throughout United States. Address C. S. Wood, 410 S. 15th St., Philadelphia, Penn.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesman Address G. L. Simonds & Co., 802 Steinway Bldg., Chicago, Ill.

ACTIVE AGENTS wanted to handle an engine room and water-works specialty of great merit; we will give exclusive territory; a well paying proposition for energetic man. Box 599, Power.

AGENTS WANTED to sell forced draft blowers and damper regulators; will give exclusive territory to right parties; commission on sales. Turbo-Blower Co., 30 Church St., New York.

WANTED—Thoroughly competent experienced mechanical rubber salesman for the city of Chicago; must have an acquaintance among the large buying trade; state age and experience; also give references. Address Box 814, Trenton, N. J.

AGENTS selling to steam plants can make big money selling for us; no samples; no experience is necessary. Armstrong Mfg. Co., Springfield, Ohio.

REPRESENTATIVES WANTED in every territory to sell high grade staple product on profit sharing basis to power plants of all description; excellent side line. Full particulars on application to P. O. Box 404, Newark, N. J.

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MISCELLANEOUS

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PATENTS SECURED—C. L. Parker, Patents, 904 G St., Washington, D. C.

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ONE 20x48-in. Allis-Chalmers heavy duty Corliss engine, with 16-ft.x39-in. flywheel, and one 24x42-in. Filer & Stowell heavy-duty Corliss engine, with 17 ft. 6-in.x50-in. flywheel; both engines are in first-class condition. T. E. Rust, chief engineer, W. C. F. & N. Ry., Waterloo, Iowa.

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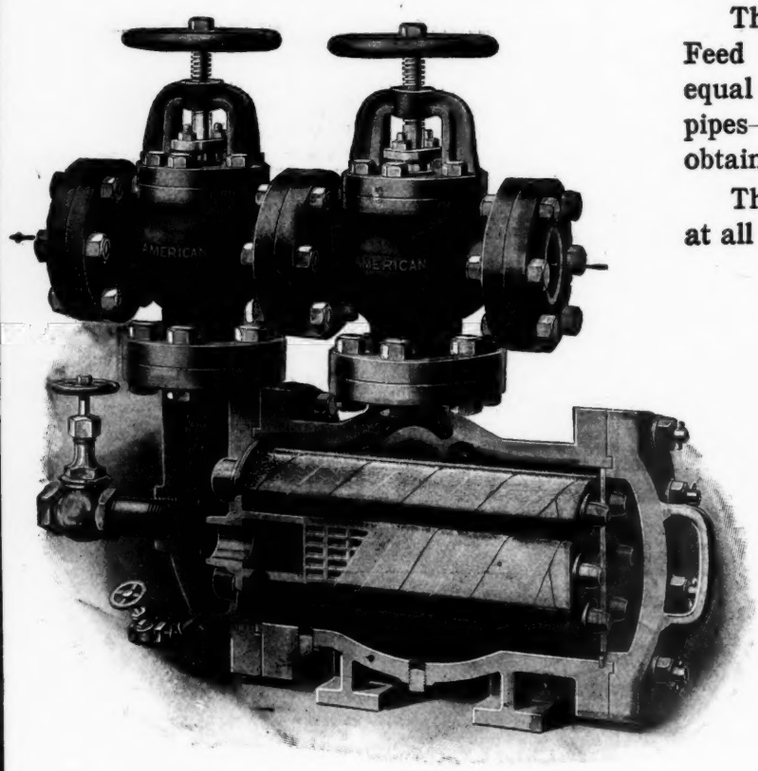

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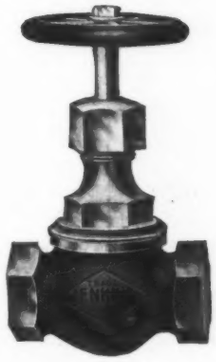

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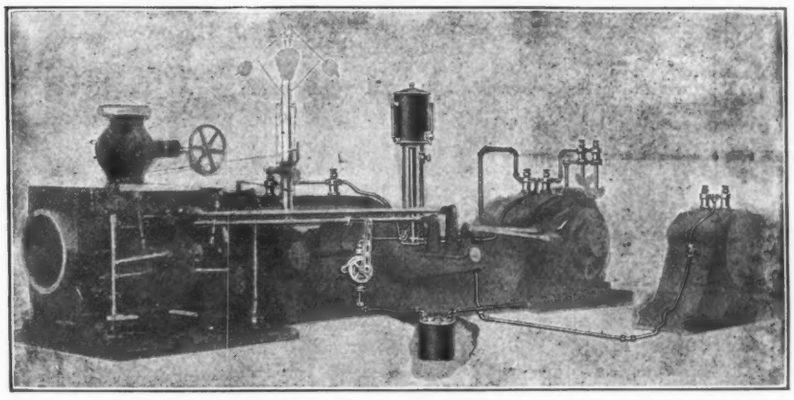

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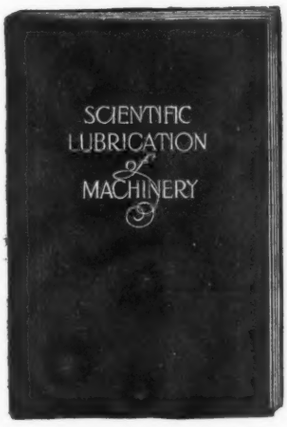

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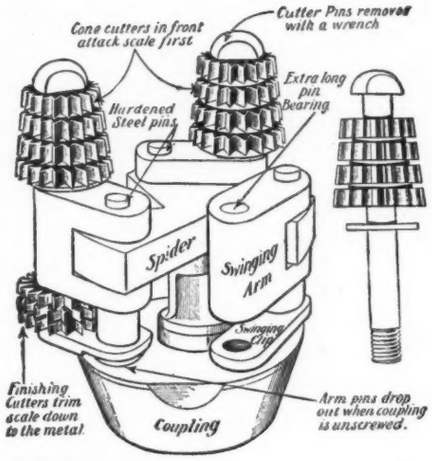
You Don't Need a Diagram To Take the Quick Repair Head Apart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Swinging Arm
Swinging Clip
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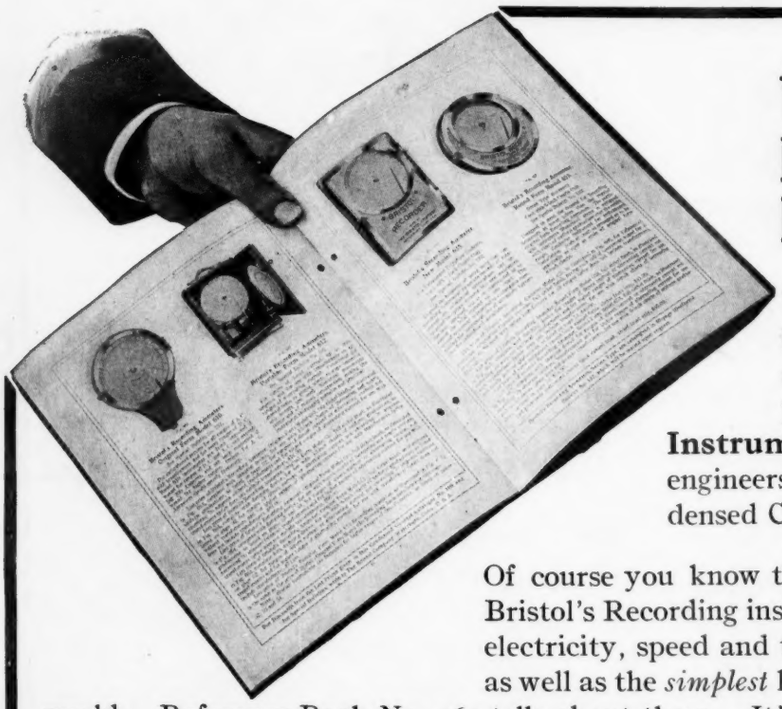

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